The Electrical Industry's Weekly Magazine July 17, 1961

Electrical World

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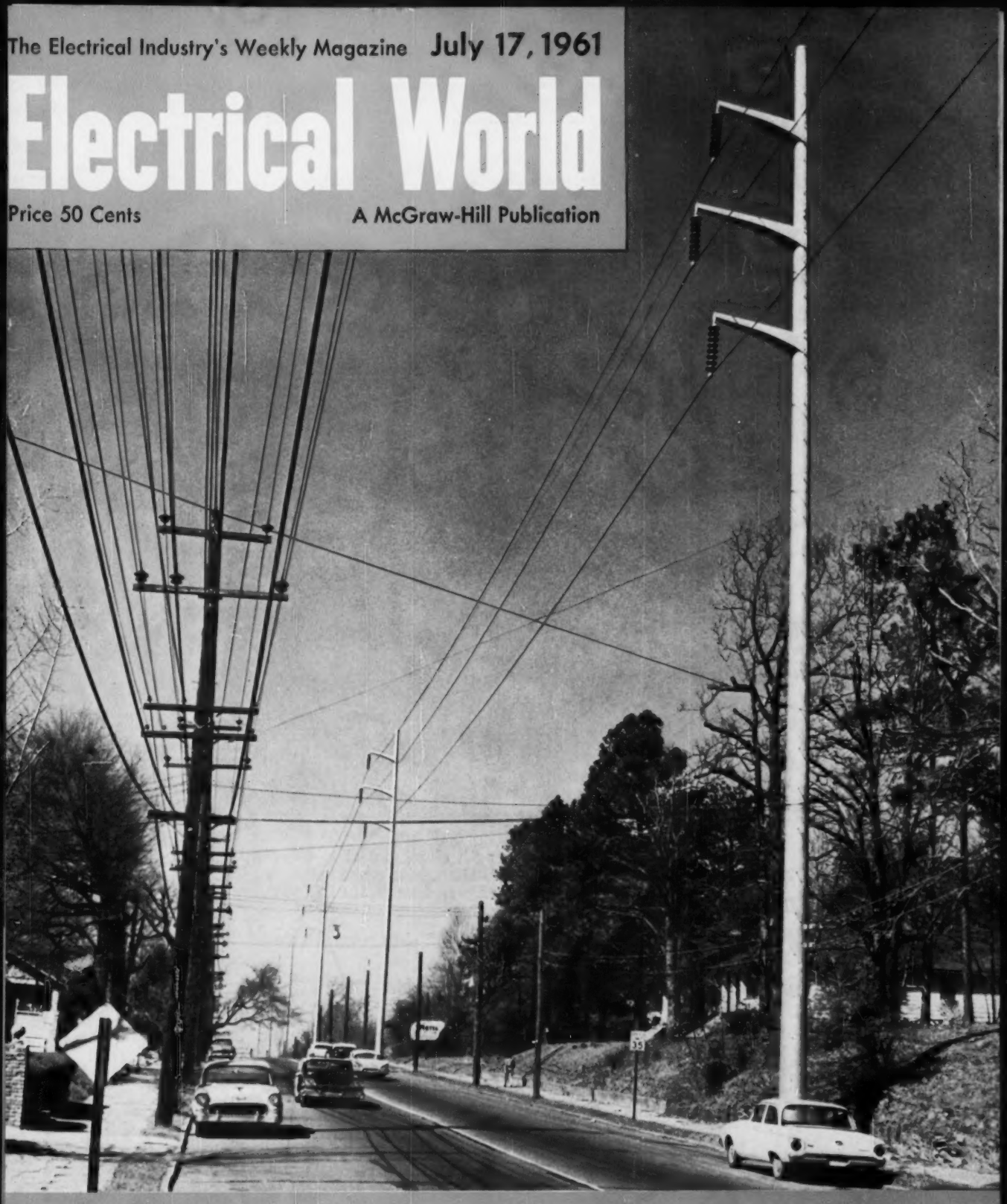

115-Kv Overhead Carries 200 Mw Over City Streets ...p 4

AIEE Summer General Meeting..

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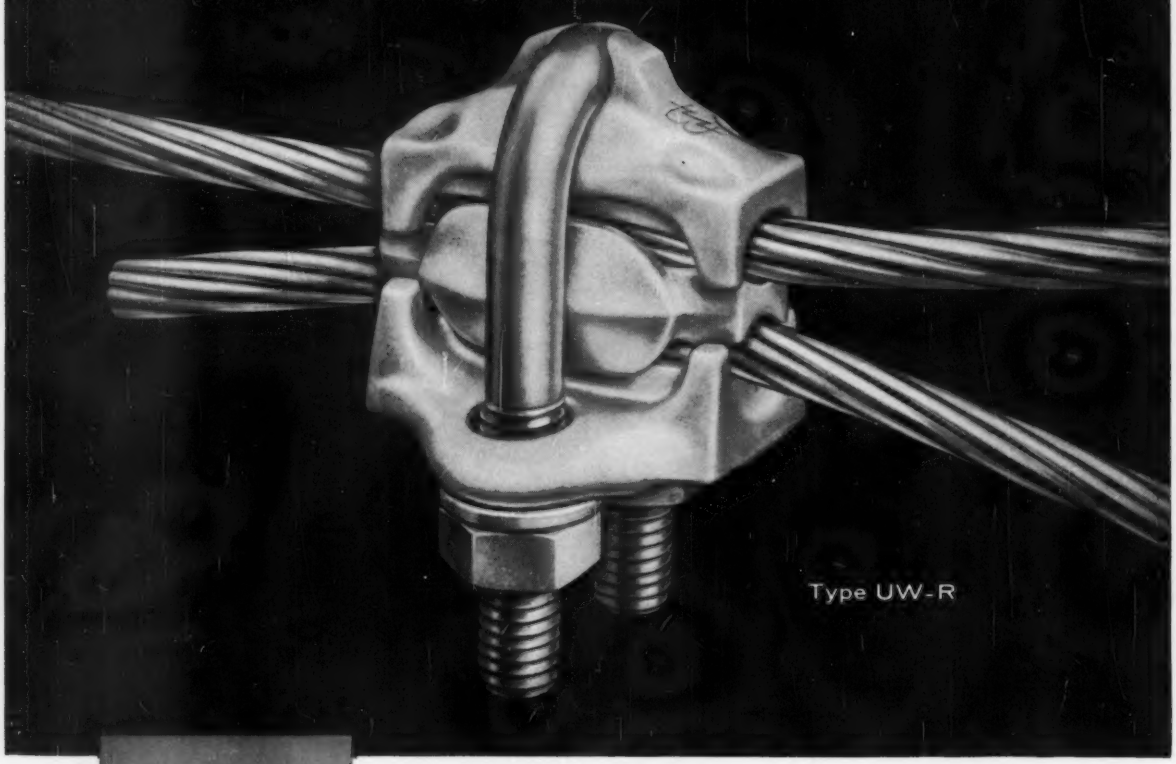
CLIPIT

low cost DEADEND for ACSR and Aluminum



Generous wrap-around CLIPIT spacer, coated with corrosion inhibiting compound, assures good conductivity when using CLIPIT as a tap connector

The high strength aluminum alloy CLIPIT deadend offers low cost, easy installation, wide range and versatility.
For reliable field performance, the CLIPIT, type UW-R, has these engineered features:

- Wide cable range: 2 sizes cover #6 thru 2/0 aluminum or 1/0 ACSR.
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58-13

Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

July 17, 1961
Vol. 156, No. 3

Dateline . . .

The Projects Call for Local Initiative

Depressed Rural Areas, USA—Investor-owned electric utilities can have a role in aid for depressed rural areas, but the part they play will depend almost entirely on what they do individually. There will be little or no encouragement from the government, but their participation will be welcome if they choose to be active as a local business. This is the essence of information given to *Electrical World* by John Baker, director of the Agriculture Department's credit services.

This attitude does not apply only to investor-owned utilities, however. What Baker wants, and what he says Agriculture Secretary Orville Freeman wants, is local initiative from any established interested businesses or organizations in or near a rural depressed area. Exceptions to this may take place in Tennessee and Arkansas and a few other places where the economics are so critical the government might give redevelopment leadership.

Just as a reminder, last spring Congress passed an area development act providing $394 million for aid to depressed areas. Only $100 million of this is designated for depressed rural areas, plus some of the $94 million for job retraining, research, etc., in the form of grants. The $100 million is for lending at an interest rate based on the current average yield of Treasury marketable obligations plus 1% for handling charges. Borrowers of the federal money would be new businesses or industries locating in the depressed rural areas—not the local interests (such as utilities) that might encourage the new enterprises. The government can loan only up to 65% of the value of the project, with the remainder coming from local interests.

What is the potential for the aid available?

From the office of William L. Batt Jr, who heads the new Area Development Administration, it is learned that of the 3,000 rural counties in the country, about 500 (and this is given as a very rough estimate) can be considered "depressed." Determination of "depressed" will be based on **(1)** unemployment, **(2)** underemployment, **(3)** low income, **(4)** standard of living, and **(5)** rate of emigration from the area. Census Bureau information is used by the Agriculture Department to determine which

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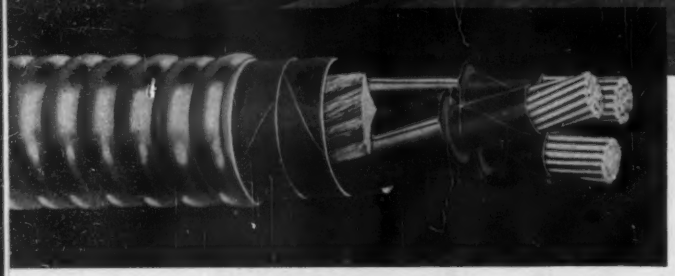

EASILY HANDLED—Neat, compact arrangement of 2300-volt power feeders shows how easily Loxarmor cables are handled. These circuits serve a new 15,000 kva "packaged" substation.

A LOOK INSIDE—This cut-away shows details of the quality construction that is part of every Loxarmor cable. An additional advantage is available in an Okoseal (polyvinylcholoride) jacket which can be supplied over and under the Loxarmor where environmental conditions warrant.

LOXARMOR®—the interlocked cable that bends itself to your will

You're the boss when you specify Loxarmor, Okonite's interlocked armor cable. Whether you require galvanized steel, aluminum, bronze or copper protection, Loxarmor is manufactured to your specifications. And Loxarmor cables are easily handled at both vertical and horizontal bends, as well as in crowded locations where circuits must be bent around piping and other apparatus.

Because of its installation economies, Loxarmor is finding increasing use in primary and secondary feeders, power and lighting circuits, station auxiliaries, control circuits, and motor circuits in place of rigid conduit systems.

Here are a few of the many advantages of Okonite Loxarmor cables:

Lower material and installation costs save money . . . additional circuits are easily added . . . circuits are easily rerouted . . . accessibility of Loxarmor reduces downtime . . . flexible, compact construction reduces space requirements. And the strict quality control under which Loxarmor is made, contributes to its continued record of superior service in the field. It all adds up to Okonite Cable'bility* —the ability to design and manufacture electrical cables that give outstanding performance.

To learn more about Loxarmor write for Bulletin EW-1090. The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

*Cable'bility . . . cable craftsmanship since 1878

***where there's electrical power . . . there's* OKONITE CABLE**

6875

Dateline . . .

Depressed Areas (*Continued from page* 3)

areas qualify, and the department in turn makes recommendations to Batt's office. Local interests can aid the Agriculture Department in collecting evidence, but its evaluation is strictly up to the Agriculture Department and classification is up to the Area Development Administration.

Electric cooperatives in the areas that are or will be classified "depressed" have a better opportunity for local prominence and leadership, even though investor-owned utilities in the area have (in theory) equal opportunity.

For example, co-ops and investor-owned utilities alike can borrow REA Section 5 money at 2% for reloaning to rural customers to finance the purchase of electrical machinery and equipment. In practice, however, only cooperatives use this money.

Also, REA is a branch of the Agriculture Department, and is even attempting to become the lending agency for the $100-million rural area development funds.

Perhaps most important spread in the difference between investor-owned and cooperative electric utilities, as far as interest in participating in the redevelopment program is concerned, is that National Rural Electric Cooperative Assn (NRECA) is serving as a stimulator to the co-ops in getting on the rural area development bandwagon. There is no counterpart at the service of the investor-owned utilities. NRECA encourages its members to take part on the basis of load building, of course, but there is a local prestige factor of interest, too. Also, the program provides an opportunity to get industrial or commercial customers on co-op lines under the banner of area economics.

How investor-owned utilities fare in this new government-sponsored program depends largely on where they stand when a development program is initiated in their individual territories.

Letters

Where Is Hall of Fame?

To the Editor:

Your story on page 47 of the June 5 issue of *Electrical World* titled "Hall of Fame Welcomes Thomas A. Edison" was interesting and, of course, timely.

Those of us who are graduates of New York University, particularly its College of Engineering and Arts and Pure Science, are most proud of the fact that the Hall of Fame is located on that campus (at 181st St and University Ave) in the Bronx, New York City.

R. H. Kilmore
Lafayette, Ind.

Pole Gin for Down Under

To the Editor:

Suggest that arrangements be made to send all available units of pole gins (design D) to our friends down-under Australia because if used as illustrated on page 69 (even the page number is upside-down) of *Electrical World* June 19, that would be one of the few localities where this application could be used.

Roland W. Meade
Baltimore Gas & Electric Co

◀ Oopps! We're sorry.

Electric Heating Can Compete

To the Editor:

Your letters column in the June 12th issue states that "our studies appear to indicate that the installations (of electric heating) are more likely to be made in new homes than as replacements for other heating systems in old homes."

You may be interested to know that approximately 70% of our business is involved in converting existing homes into much better climate control, and the base for this, of course, is electric heating and very inexpensive air conditioning. It is also very encouraging to find that operating costs in the central states, at the 5,600 degree level, and at a 1.5¢ rate, can be always less than 15¢ per sq ft and average downward to about 10¢ per sq ft per heating season.

Clement L. Stanford
Electriliving Corp, Indianapolis, Ind.

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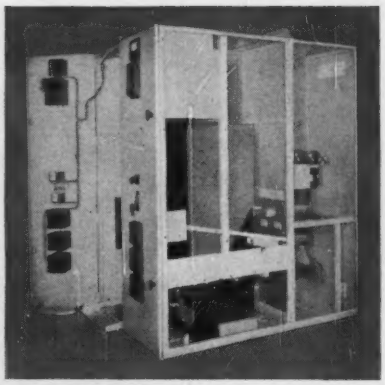
More features make Westinghouse metal-clad switchgear

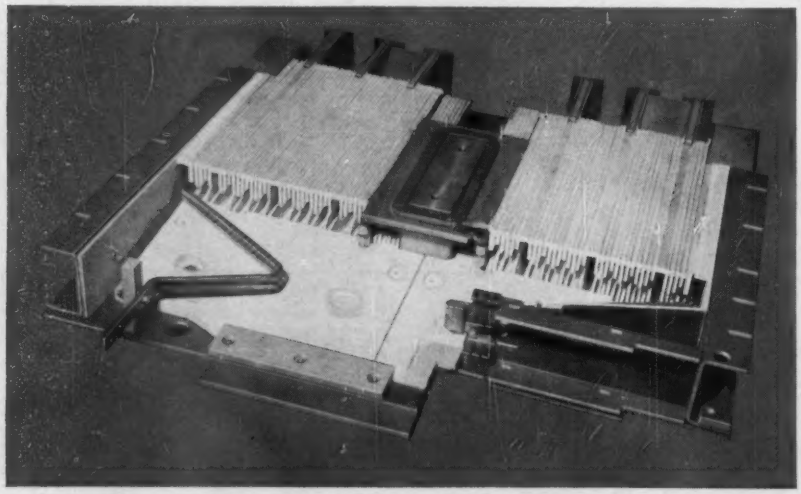
Westinghouse metal-clad switchgear is design proved in the Westinghouse High Power Laboratory. It meets all industrial, electric utility, commercial, institutional, and other needs for 75 to 1000 mva service inclusive, 4.16 through 13.8 kv.

Check below for advantages of this equipment that are of major importance to you.

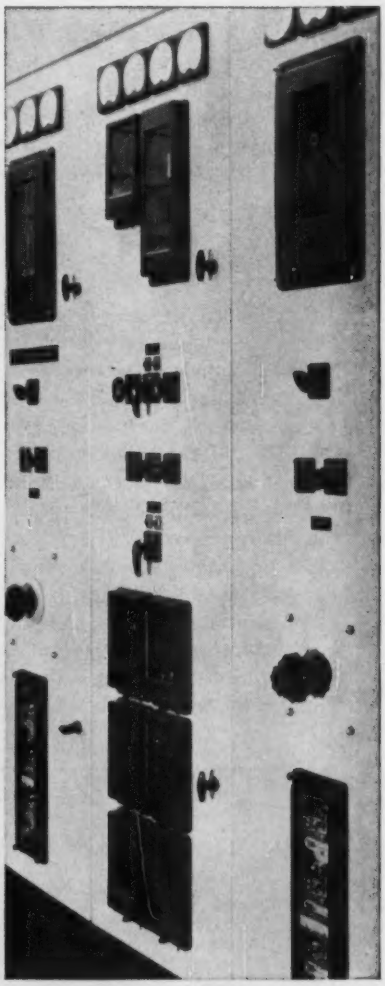
For further information, call your Westinghouse representative or write for a copy of Descriptive Bulletin 32-250 to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. *You can be sure . . . if it's Westinghouse.*



Balanced insulation protection is provided by the exclusive "Limitrak" insulation system on bus supports, arc chute enclosure and breaker bushings.

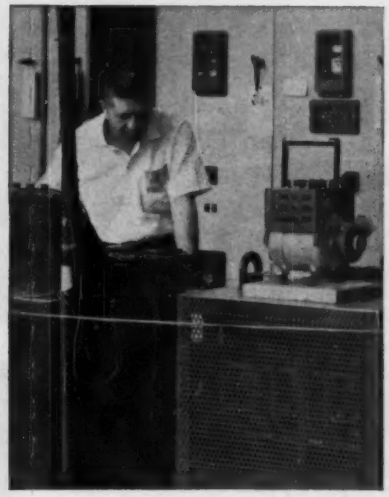


Fast, positive circuit protection is provided by the De-ion principle of arc interruption with center coil arc chute design.

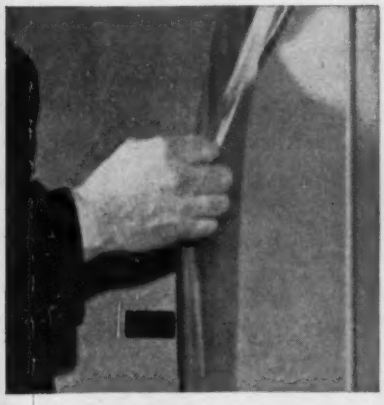


Adequate space for varied relaying and instrumentation is assured by full height front panels.

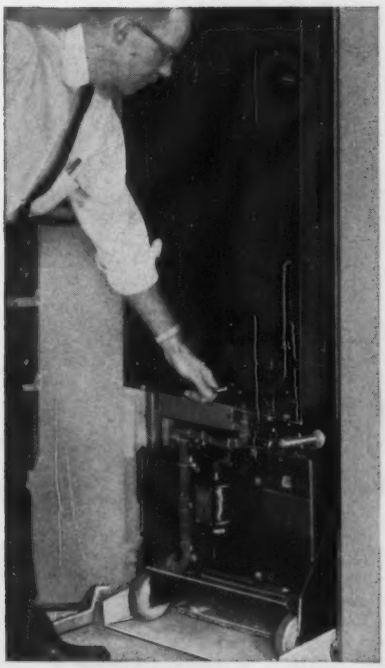
your best buy



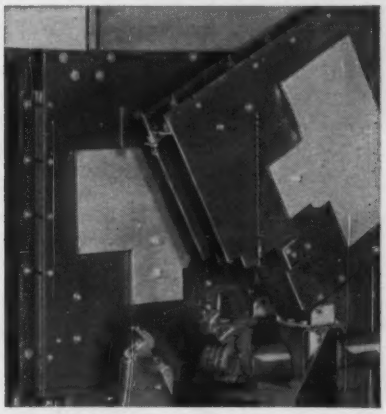
Proper component functioning is verified by a continuing program of production inspection and testing.



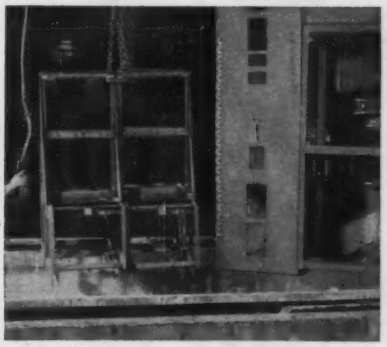
Front panel is protected during assembly, shipment and installation by strippable plastic coating.



Simple, quick inspection, maintenance and replacement of DH breakers is made possible by horizontal drawout construction.

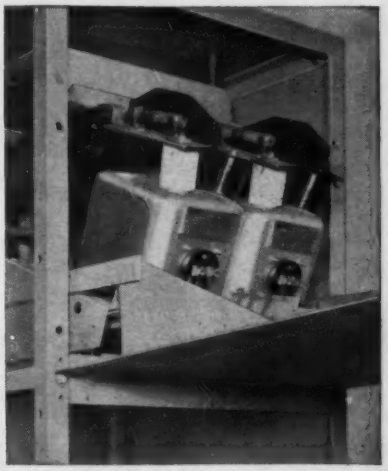


Hinged arc chute permits easy tilting for inspection and maintenance of contacts with DH breaker in drawout position.



Thorough phosphatizing and priming treatment safeguards against corrosion and provides a superior base for finish coat.

Complete joint sealing with polyester compound at main contact supports and main bus provides full insulation.



Personnel are protected by separate compartment drawout-type mounting of potential transformers.

Westinghouse

J-61014

BROADER WARRANTY . . . . . GREATER ECONOMY AND DURABILITY '61 FORD TRUCKS

The new extended warranty for all 1961 Ford Trucks is just one example of the many ways Ford gives you maximum protection for your truck investment. Each part, except tires and tubes, is now warranted by your dealer against defects in material or workmanship for 12 months or 12,000 miles, whichever comes first. Warranty does not apply, of course, to normal maintenance service or to the replacement as normal maintenance of such items as filters, spark plugs and ignition points.

The excellent fuel economy of Ford's modern 223-cu. in. Six has been proved in certified tests by independent experts over a 3-year span. Front tires on Ford conventional ½-tonners also lasted up to twice as long as those on other makes with independent suspension.

In addition to price, fuel and tire savings, 1961 Ford Trucks provide greater freedom from nuisance problems that crop up with other trucks. Ford's rigid quality controls give you the strongest safeguard of truck reliability ever. Fords stay on the job . . . out of the shop!

F-100 Chassis-Cab models have new stronger frame for greater durability and longer wheelbase for smoother ride. 28% more glass area in cab gives you new wide-angle view to front, sides and rear.

New Econoline Van . . . modern cab-forward design gives as much as 80 more cubic feet of cargo space in nearly three feet less length than leading conventional half-ton panels. It's America's lowest-priced* van and can cut yearly operating costs by $100 or more.

New 4-wheel drive pickups . . . priced to save you plenty, Ford's 4 x 4's come in ½- and ¾-ton capacities. They're tougher than ever with stronger frame, improved suspension and new optional heavy-duty front axle on ¾-tonners.

*Based on a comparison of latest available manufacturers' suggested retail prices

ALL-NEW
FORD "BIG SIX"
262-cu. in. engine

Now, the economy of a Six is combined with the dependability of heavy-duty, exclusive-truck engine design. In independent tests, Ford's new Big Six was pitted against the major competitive Six. Certified† result: Ford Trucks gave 13.5% better gas economy! And Ford recommends 34% fewer service operations in 25,000 miles of customer service. This means less time in the shop . . . more time on the job.

The new Big Six is one of four engine choices in Ford F-600 trucks for '61—including America's most popular truck V-8's.

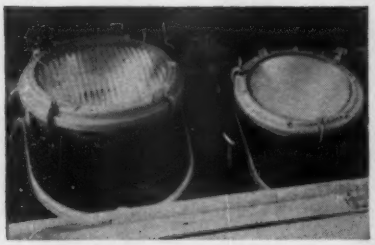
†*Tests simulated typical city delivery and shuttle service*

FORD TRUCKS COST LESS

SEE YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" FOR PROOF!

FORD DIVISION, Ford Motor Company,

Industry-proved through a quarter century of service . . . THERE'S NO DOUBT ABOUT NEOPRENE



To avoid detracting from appearance of the monument, two inner rings of lights are enclosed in tasteful, unobtrusive vaults. A third ring is located 650 ft. away from the structure. For maximum reliability, time-proven neoprene jacketed cable was specified for the entire installation.

NEOPRENE JACKETED CABLE USED EXCLUSIVELY IN NEW WASHINGTON MONUMENT LIGHTING SYSTEM

As part of the National Park Service "Mission 66" program, a newly installed lighting system at the Washington Monument delivers 14 times the illumination value of previous systems. Now the giant 555-ft. landmark is illuminated by three rings of powerful prefocused floodlights that deliver more than 100 million candlepower. The cable, supplied by National Electric Division of H. K. Porter Company, Inc., is jacketed exclusively with time-proven Du Pont *neoprene*.

Neoprene was the logical choice for this important installation because no other jacketing material has such an outstanding combination of properties. Tough and weather-resistant, neoprene jacketing retains its resilience despite extremes of heat and cold . . . resists deformation and flow from heat or pressure . . . withstands ozone and abrasion. Moreover, neoprene will not support combustion.

For more than 25 years, neoprene has proven its dependability in many different kinds of cable jacketing applications. For regular reports on the use of neoprene in the electrical industry, write for your free subscription to the WIRE AND CABLE CASEBOOK. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department EW-7, Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.

NEOPRENE
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

NEW

Delta-Star DS-50 Distribution Transformers

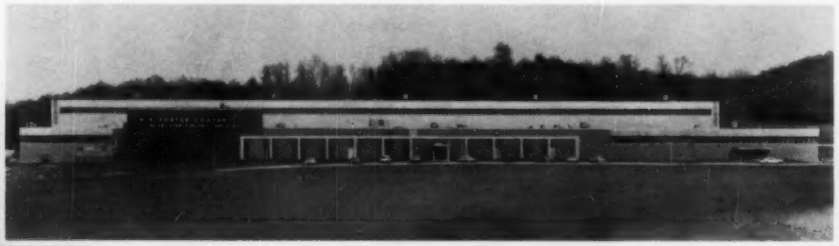
Short circuit capability 50 times rated current

Aluminum strip coil, new Porter core designed for automated production in new transformer plant . . .

Delta-Star's new DS-50 Transformer was designed to provide electric utilities with the benefits of recent technical advancements in core fabrication and strip winding techniques. This new design break-through establishes a new high in transformer value . . . including a short-circuit capability of 50 times rated current. Even more important, these new design developments provide a new base from which further transformer advances may be made.

Porter's pioneering with low-operating-cost transformers, and *NOW* a really new core and coil, continues its contribution to efficiency and economy in electrical distribution. In 1959 Delta-Star Division introduced low-loss, low-operating-cost transformers with 2.5 to 1 ratio of losses. They were also among the first to offer plastic coated covers on Distribution Transformers. Such pioneering has resulted in improved transformers and savings for transformer users.

Winding aluminum strip coils.



New manufacturing plant in Lynchburg, Va., with 6 acres under roof is one of Delta-Star's three transformer plants.

Automated tank fabrication line

For complete information and specifications on the new Delta-Star DS-50 Distribution Transformer, write: *Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 W. Fulton St., Chicago 12, Ill.*

PORTER ***DELTA-STAR ELECTRIC DIVISION H. K. PORTER COMPANY, INC.***

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JULY 17, 1961
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FOUR CORNERS project taps Navajo coal to power Arizona system.

LATE NEWS ▸ **Three public power groups are filing proposals requested by the AEC** to participate in a 50-Mw organic-moderated power reactor project. They are Grand River Dam Authority, Vinita, Okla.; Burlington Light Department, Burlington, Vt.; and Plains Electric Generation & Transmission Cooperative, Albuquerque, N. M. The AEC asked for the formal proposals after it received and evaluated initial expressions of interest from four additional publicly-owned utilities.

In a precedent-setting decision for the state, the Mississippi PSC rules that Mississippi P&L shall "cease and desist" expansions of its service into newly annexed areas of two towns. The decision reserves the rights of two rural electric power associations already serving the disputed areas to continue services which had been allowed under franchises granted before the two cities, Clinton and Winona, extended corporate limits.

FPC grants a license to the City of Seattle for a $97-million, 810-Mw hydro project at the boundary site on the Pend Oreille River, Pend Oreille County, Wash. The boundary project had been unsuccessfully contested by Pend Oreille PUD No. 1, which wanted to build a rival, "Z Canyon" project 1.3 miles upstream from the boundary site.

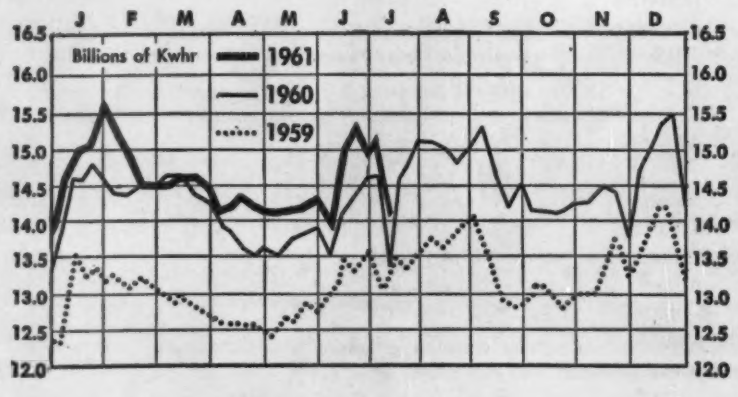
Hearings on Arizona Power Authority's proposed Marble Canyon project are postponed by FPC to Sept. 12. The city of Los Angeles and the Metropolitan Water District of Southern California are challenging Arizona's application for the Colorado River project as inadequate.

American Electric Power Corp awards contract for 420 aluminum transmission towers for a 122-mile, 345-kv line to Kaiser Aluminum & Chemical Corp. The V-shaped towers will require only a single foundation and will be guyed by four wire anchors. Contract price is not available, but construction of the entire line will cost about $8 million.

Potential new Alaskan hydro-power projects are reported by the US Geological Survey involving 240-Mw of capacity. Largest would be at Lake Chakachamna, 80 miles west of Anchorage, where a 10-mile tunnel from the glacial lake into the McArthur River valley would develop a head of 1,000 ft. The Chakachamna project would have 200-Mw capacity, with power slated principally for Anchorage. Three other small projects, totaling 40-Mw capacity, would be on the Kenai Peninsula.

WEEKLY POWER OUTPUT—Up 5.4%

(Week ending July 8), Kwhr 14,133,000,000



Percent Change From Previous Year

	June 24	July 1	July 8
Total U. S.	+ 1.8	+ 3.7	+ 5.4
New Eng.	+ 7.2	+ 4.6	+ 5.6
Mid. Atlan. ...	+ 4.3	+ 2.4	+ 6.9
Cent. Indust. ..	+ 2.0	+ 5.2	+ 5.7
West Cent.....	+ 2.6	+ 7.7	+13.3
Southeast	+ 0.6	+ 1.2	+ 2.4
South Cent. ...	−14.1	− 4.4	+ 1.8
Rocky Mount...	+11.1	+10.9	+ 9.6
Pacific			
NW	+ 3.2	+ 5.2	+ 5.0
SW	+10.9	+ 9.8	+ 6.8

Seasonally Adjusted Index 286

Week Ago 285 Year Ago 273

Source: Edison Electric Institute

Supply Lines

EUROPEAN ORDERS BOOST US NUCLEAR REACTOR MANUFACTURERS

Upswing for US nuclear reactor manufacturers seems to be starting, with most of the impulse coming from the Euratom countries. The newest announcement, the 313-Mw plant that General Electric Co will design and fabricate for Pacific Gas & Electric Co, is the only new domestic item and the only firm plant contract. Those from abroad are largely for studies, but serious studies that seem likely to lead to eventual construction.

These create activity for the manufacturers' reactor design groups, which have had little come their way in the last year and a half. At least one of the studies seems to offer a departure from present designs, probably in an effort to reduce fuel cycle cost. This is a 250-Mw, homogenized pressurized-heavy-water reactor, on which Westinghouse Electric Corp is to conduct a feasibility study for the Swedish atomic energy authority.

These announcements come at the same time that Euratom leaders are making optimistic predictions about the growth of nuclear power in their lands. Euratom President Etienne Hirsch last month told the six-nation European Community's parliament, "By 1970 or even earlier, reductions in production costs . . . will insure a position for nuclear power that is competitive with conventional forms of electricity production" in the Euratom countries. Paul Hubert de Groote, Euratom commissioner, was even more optimistic in a May speech. He predicted competitive nuclear power in Europe by 1965 and expected half the capacity added between that year and 1970 to be nuclear, two-thirds in the following decade. Even if nuclear power does not become competitive by 1970, he expected the nuclear capacity required by 1980 to be 25,000 Mw. If competitive, that figure should go to 40,000 Mw.

The latest development is a contract to Allis-Chalmers Manufacturing Co with Sweden's Atomkraftverk (AKV) for preliminary design of a 56-Mw boiling-water reactor. And the Dutch utility organization, NV Samenwerkende Electriciteits-Productiebedrejven (SEP), has awarded General Electric a design study on a 50-Mw boiling-water plant.

Three other developments are from West Germany. Westinghouse has a contract for studying a 150-Mw plant for Berliner Kraft und Licht AG (BEWAG). Earlier this year, Atomics International started preliminary design on a 150-Mw organic-moderated reactor contracted by Kernkraftwerk Baden-Württenberg Planungs-GmbH (KBWP), a formation of German utilities. And Rheinisch-Westfälisches Elektrizitätswerk (RWE), which is already operating the General Electric-built 15-Mw BWR at Kahl, is reported considering proposals for a 200-300-Mw unit.

LAPP BREAKS WITH TRADITION ON INSULATOR RATINGS

First evidence of a break in the long-established, tradition-bound EEI-NEMA standard ratings for suspension insulators appears this week with published announcement by Lapp Insulator Co of a new "compact," high-efficiency unit. This non-standard insulator carries a 14,000-lb M&E strength rating, is 9 in. in dia and one-third lighter, but otherwise identical in rated characteristics (and interchangeable with) the standard EEI-NEMA 52-3, 15,000-lb, 10-in. unit. Its announced price is 14% lower than the standard insulator's $2.92 price.

EEI-NEMA insulator ratings have remained essentially unchanged for well over

20 years. During this period, actual performance characteristics of suspension insulators sold under these ratings have improved steadily. But manufacturers haven't merchandised these added values quantitatively, and most users, pegged to maximum loadings as a percent of standard ratings, have been unable to take advantage of them.

The new non-standard unit, by departing completely from established M&E ratings and recent prices, injects a completely new relationship among ratings, performance and price. Capitalizing on improvements in insulator design and ceramics technology over the past two decades, it reduces the spread between performance characteristics and ratings. The manufacturer is promoting the new unit from the viewpoint that "normally-loaded" lines seldom need more than 7,000-lb working strength (half the M&E rating) anyway, and that he is sharing the reduced production costs with the buyer.

Some observers feel that the growing imbalance between ratings and performance of standard insulators is symptomatic of somewhat similar situations in other electrical equipment lines. In a sense, action taken by Lapp recalls that taken by some distribution transformer manufacturers in the still-unresolved boost to 65C temperature rise.

CITIES REPORT ON DAMAGE SUIT PROGRESS

A group of city attorneys who have studied the feasibility of filing triple damage suits in the antitrust cases have estimated that price increases resulting from the conspiracies ranged from 20% to 40% "or more" above normal. The attorneys, working through the National Institute of Municipal Law Officers, are working as a task force to study how cities could best file damage suits. A report made by the task force said 66 cities so far have reported purchases of electrical equipment during the period covered by the government indictments, worth a total of about $260 million.

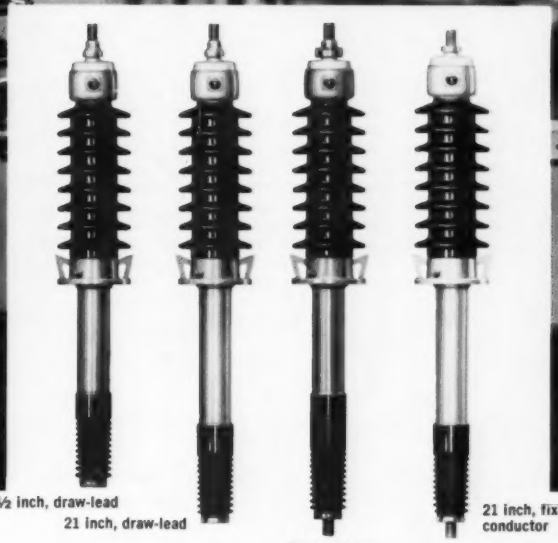
Originally, the city attorneys considered drawing up one large damage suit, but apparently they have abandoned this plan because of the complexities involved. However, the task force committee proposes that cities pool data and finances, and hire an antitrust lawyer to compile and analyze facts to simplify the filing of suits by individual cities. And the report observes, "It is also becoming more and more obvious that proof of damages will be difficult and costly. One cannot expect success in this matter without elaborate and careful preparation." A consultant hired by the task force estimated that to prepare evidence from the information collected from the first 66 reporting cities alone would cost more than $100,000.

PRICES REPUBLISHED ON MEDIUM POWER TRANSFORMERS

The medium transformer department of General Electric has announced new published prices on transformers rated 501 through 10,000 kva, all voltages. The prices, which became effective July 3, are now listed on a "net selling price basis," and are at the same levels as those announced June 14, 1960, GE says. "Also included is a reduction for 1,000-kva and 1,500-kva units," the company notes, "along with changes in price additions for certain special features. The recently announced 150C rise, ventilated dry-type transformer, is now listed as the standard dry-type offering at a price 10% above the corresponding oil-filled unit."

O-B adds new bushings

Oil-paper construction extended into ASA Table 3 bushings for transformers



16½ inch, draw-lead
21 inch, draw-lead
21 inch, fixed conductor
Breaker-Tran

O-B has added new low-voltage bushings of the Type GK, oil-paper construction, to its line of Breaker-Tran bushings. For 69 kv down to 15 kv service, O-B's low voltage Class GK bushings will complement the Breaker-Tran line by covering the common dimensional requirements for transformer bushings included in Table 3, ASA standard C76.1a-1958.

In each voltage class the 400 ampere, 16½ inch oil level and the 400 ampere, 21 inch oil level transformer bushings are designed for draw-lead application; the 1200 ampere, 21 inch oil level transformer bushing is equipped for fixed connections.

Class GK, which includes O-B's Breaker-Tran line, high voltage bushing line and new "Table 3" bushings, is a full condenser type with oil-paper construction. Its core has been precision wrapped with condenser foils inserted at regular intervals for uniform grading across the dielectric. Oil impregnates the paper core and surrounds it from end to end.

The new Class GK low voltage bushings share the qualities that give O-B condenser bushings their excellent field service record. You can get these new Class GK bushings on your equipment simply by asking for them.

OHIO BRASS COMPANY, MANSFIELD, OHIO

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10113-H1

O-B's new bushings can

TABLE OF LOW VOLTAGE CLASS GK BUSHINGS FOR O.C.B. AND TRANSFORMERS

Voltage Class	Current Rating Amperes	Application	Dist. From Gasket Surface to Min. Oil Level Inches	O-B Cat. No.	ASA Stds	Cat. No. of Breaker-Tran for 400 amp. draw lead Trans. use
69KV	400	Trans	16½	45462	Table 3	
	400	Trans	21	45463	"	
	400	Trans	27	*	"	
	1200	Breaker-Tran	16½	45465	Table 2	45464
	1200	Trans	21	45466	Table 3	
	1200	Trans	27	*	"	
46KV	400	Trans	10	*	Table 3	
	400	Trans	16½	45452	"	
	400	Trans	21	45453	"	
	1200	Breaker-Tran	16½	45455	Table 2	45454
	1200	Trans	21	45456	Table 3	
	1200	Trans	27	*	"	
34.5KV	400	Trans	10	*	Table 3	
	400	Trans	16½	45432	"	
	400	Trans	21	45433	"	
	1200	Breaker-Tran	16½	45435	Table 2	45434
	1200	Trans	21	45436	Table 3	
	1200	Trans	27	*	"	
23KV	400	Trans	10	*	Table 3	
	400	Trans	16½	45422	"	
	400	Trans	21	45423	"	
	1200	Breaker-Tran	16½	45425	Table 2	45424
	1200	Trans	21	45426	Table 3	
	1200	Trans	27	*	"	
15KV	400	Trans	10	*		
	400	Trans	16½	45402	Not	
	400	Trans	21	45403	Covered	
	1200	Breaker-Tran	16½	45405	By	45404
	1200	Trans	21	45406	ASA	
	1200	Trans	27	*		

* For these limited applications, refer to O-B

▭ Breaker-Tran Bushings. In given voltage class, one basic bushing assembly utilizing 2 terminals covers applications for oil circuit breakers and transformers at 1200 amperes and transformers with 400 ampere draw-lead.

▬ New Oil Paper Bushings (ASA Table 3 except 15KV voltage class)

help you standardize

These 4 standard units meet prevalent requirements for 69 kv service; do your specifications make use of them?

Just like these four bushings in 69 kv class, there are four O-B bushings in each voltage class down to 15 kv that meet requirements of about 95 per cent of all applications. O-B has standardized on production of these bushings; are you taking advantage of this when you specify bushing dimensions?

Take a look at the accompanying table. O-B's new type GK "Table 3" (ASA standard C76.1a-1958) bushings are indicated by color; the interchangeable "Table 2" Breaker-Tran bushings are indicated by boxes. To find the bushing catalog number, simply select your voltage class, current rating, and oil level. Opposite that line will be the catalog number of the O-B bushing. Dimensions of these bushings can be found in ASA standard C76.1a-1958 or can be obtained from O-B publication 1489-H.

These new Class GK bushings are "brothers" to the Breaker-Tran bushings in construction detail. Above the flange the appearances are very similar. Below the flange you'll notice the important dimensional differences. Internal oil-paper construction with condenser foils wrapped integrally in the paper core is the same high quality used in the Breaker-Tran.

You will find many advantages in employing O-B's new Class GK bushings on your equipment. You'll get the assurance of a perfect field record of O-B Class GK bushings. You can have the advantage of complete manufacturer's stocks and simplified inventory in your own stock. And, every advantage of industry standardization is yours, when you specify O-B bushings.

They are now available on new apparatus. Merely express your preference when placing orders for equipment and O-B Class GK bushings will be supplied.

OHIO BRASS COMPANY, MANSFIELD, OHIO

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* PLM'S ALUMINA SPACERS and
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Don't pay needless money for future tree trimming!

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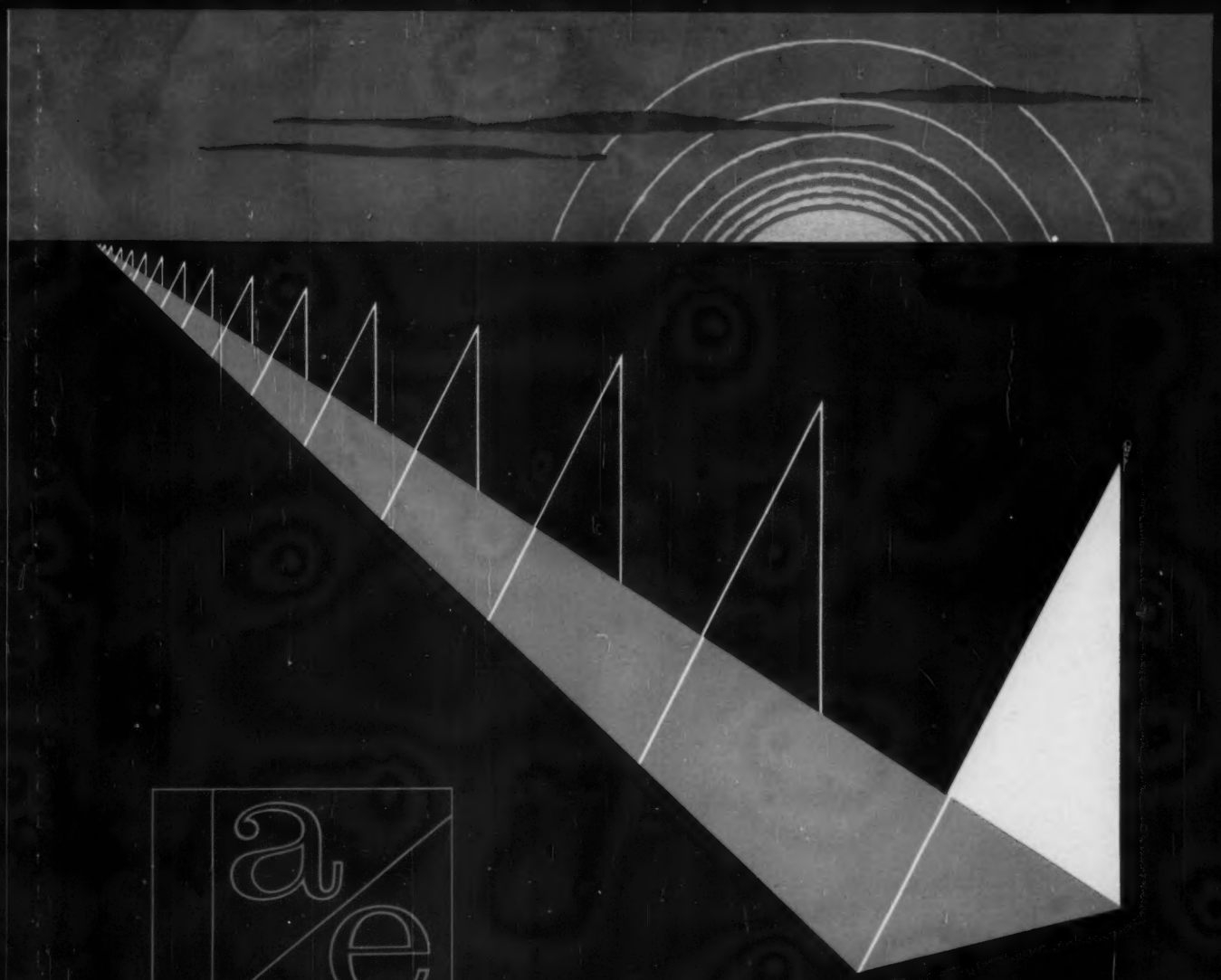

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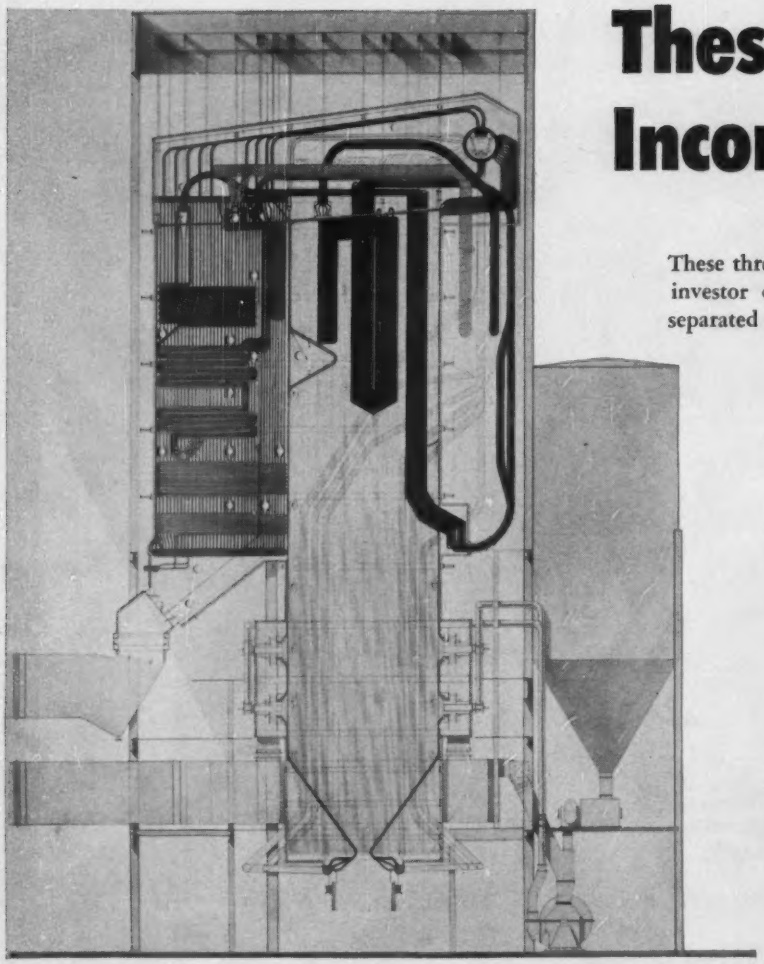
STREET LIGHTING CONTROLS

Improved RCA cell, same reliable circuitry, smaller size

Here's the first photoelectric street lighting control to use RCA's improved cadmium cell. The light sensing element is glass enclosed like a vacuum tube to insure a positive hermetic seal. Failure from atmospheric leaks is practically eliminated. *Not new,* however, in American Electric's 8000-1 Control is a special arrestor which protects components from repeated surges. (We introduced an arrestor on our first cadmium cell control three years ago . . . now all manufacturers' controls are similarly equipped.) This combination of features, utilizing the same proven reliable circuitry, assures you of greater dependability than ever before in automatic street lighting control. For appearance, Model 8000-1 has a modern low silhouette and molded acrylic cover; for convenience one unit fits both old and new style luminaire heads. Test this better control on your street lighting system. Phone or write today.

American Electric Manufacturing Corp., 3271 Chelsea, Memphis 8, Tenn., *Representatives throughout the U.S.*



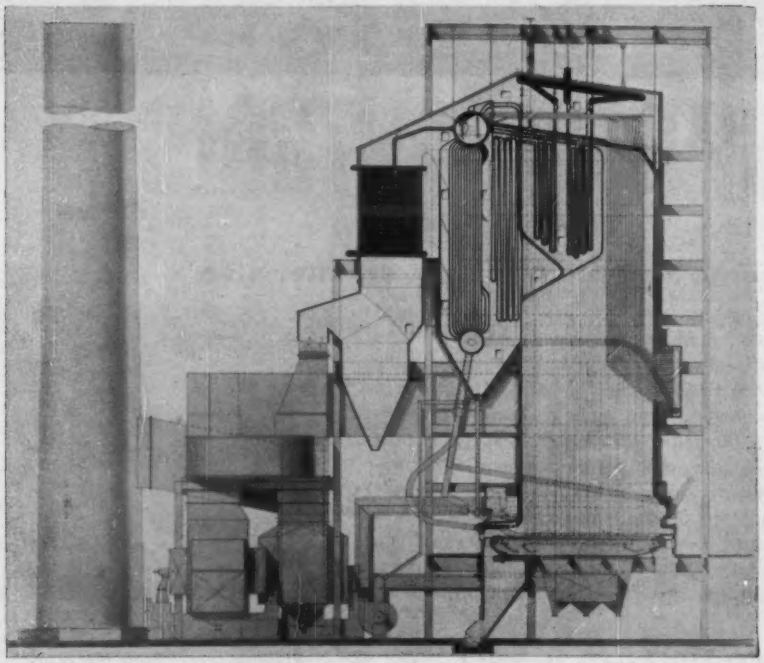
These RILEY Incorporate The

These three Riley boilers are being built for three investor owned electric utilities in three widely separated sections of the country. Featured in these designs are some of the most recent Riley engineering developments, such as the Riley *Turbo Furnace,* new superheater and reheater arrangements, new high capacity steam washer, use of radiant superheater platens, multiple downcomers for uniform distribution of feedwater, opposed wall firing, new '60 type Riley Flare Type Burners and Pulverizers, and the world's largest spreader stoker.

Left —

For A Central Station — Southeast

This dry bottom balanced draft pulverized coal fired unit is a 1,700,000 lbs/hr unit, 2525 psi at superheater outlet, 1005F superheat and 1005F reheat. The unit is fired by five No. 550E Riley Pulverizers and twenty Riley Flare Type Burners with two rows of five burners in the front and rear walls. This boiler will be completely automated.



Opposite Page —

For A Central Station — Southwest

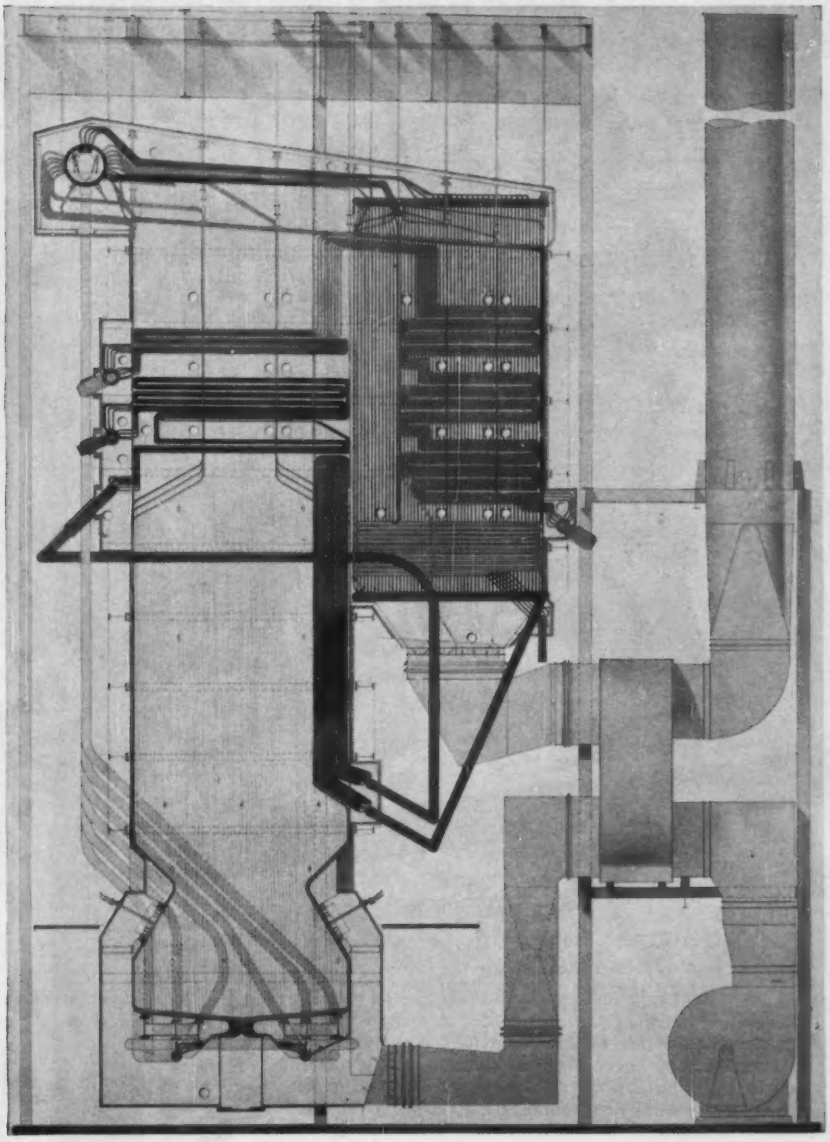
This is a gas fired Turbo Furnace Unit having a normal capacity of 2,486,000 lbs/hr, 2425 psi, and a peak capacity of 2,668,000 lbs/hr at 2590 psi superheater outlet pressure, 1005F superheat and 1005F reheat. It is designed for pressurized operation without induced draft fans, and for future pulverized coal firing with merely the addition of water tube platens.

Left —

For A Central Station — Northwest

This unit will be by far the largest spreader stoker fired lignite burning boiler. The Riley Traveling Grate Spreader Stoker is 38′-0″ wide by 27′-0″ shaft centers. The boiler is designed for a continuous capacity of 650,000 lbs/hr, 1300 psi, superheater outlet 955F, and a peak capacity of 685,000 lbs/hr. It will burn 6680 Btu. North Dakota lignite. Among the reasons for selection of spreader stoker firing of lignite were the large savings in power and maintenance over pulverized coal firing.

Central Station Boiler Designs Latest Riley Engineering Features



Some Electric Utility Riley Customers

Arizona Public Service Co.
Carolina Power & Light Co.*
Central Power & Light Co., Texas
Kansas Gas & Electric Co.
Holyoke Water Power Co.*
Minnesota Power & Light Co.*
Eastern Iowa Light & Power Co.
Philadelphia Electric Co.*
Louisiana Power & Light Co.*
Texas Electric Service Co.*
Public Service Company of Indiana, Inc.*
Arkansas Power & Light Co.
Utah Power & Light Co.*
Columbus & Southern Ohio Electric Co.*
Central Illinois Light Co.*
Houston Lighting & Power Co.*
South Carolina Electric & Gas Co.*
Union Electric Co., Missouri*
Southern Nevada Power Co.
Commonwealth Edison Co.
Florida Power Corporation*
Dallas Power & Light Co.*
Monongahela Power Co., —
The Potomac Edison Co.*
Delaware Power & Light Co.
Southwestern Gas & Electric Co.
Northern States Power Co.
Central Louisiana Electric Co.*
Gulf Power Co.*
Pennsylvania Electric Co.
Iowa Electric Light & Power Co.*
Montana-Dakota Utilities Co.*
Mississippi Power Co.*
Ohio Edison Co.*
Iowa Public Service Co.*
Interstate Power Co.*
Pacific Gas & Electric Co.
Southern Indiana Gas & Electric Co.
Upper Peninsula Power Co.
New Orleans Public Service Inc.*
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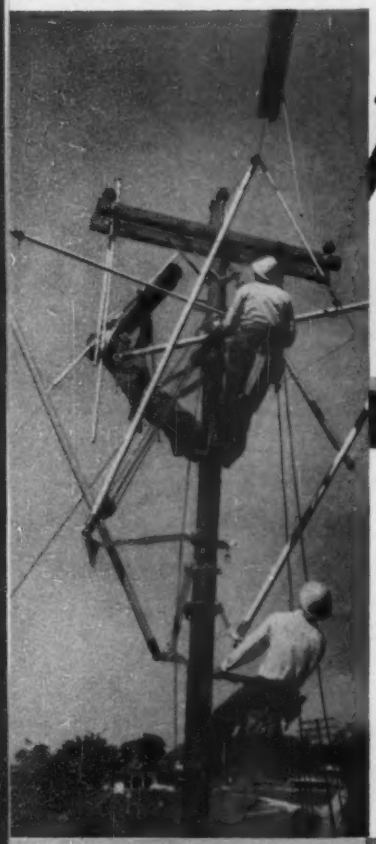
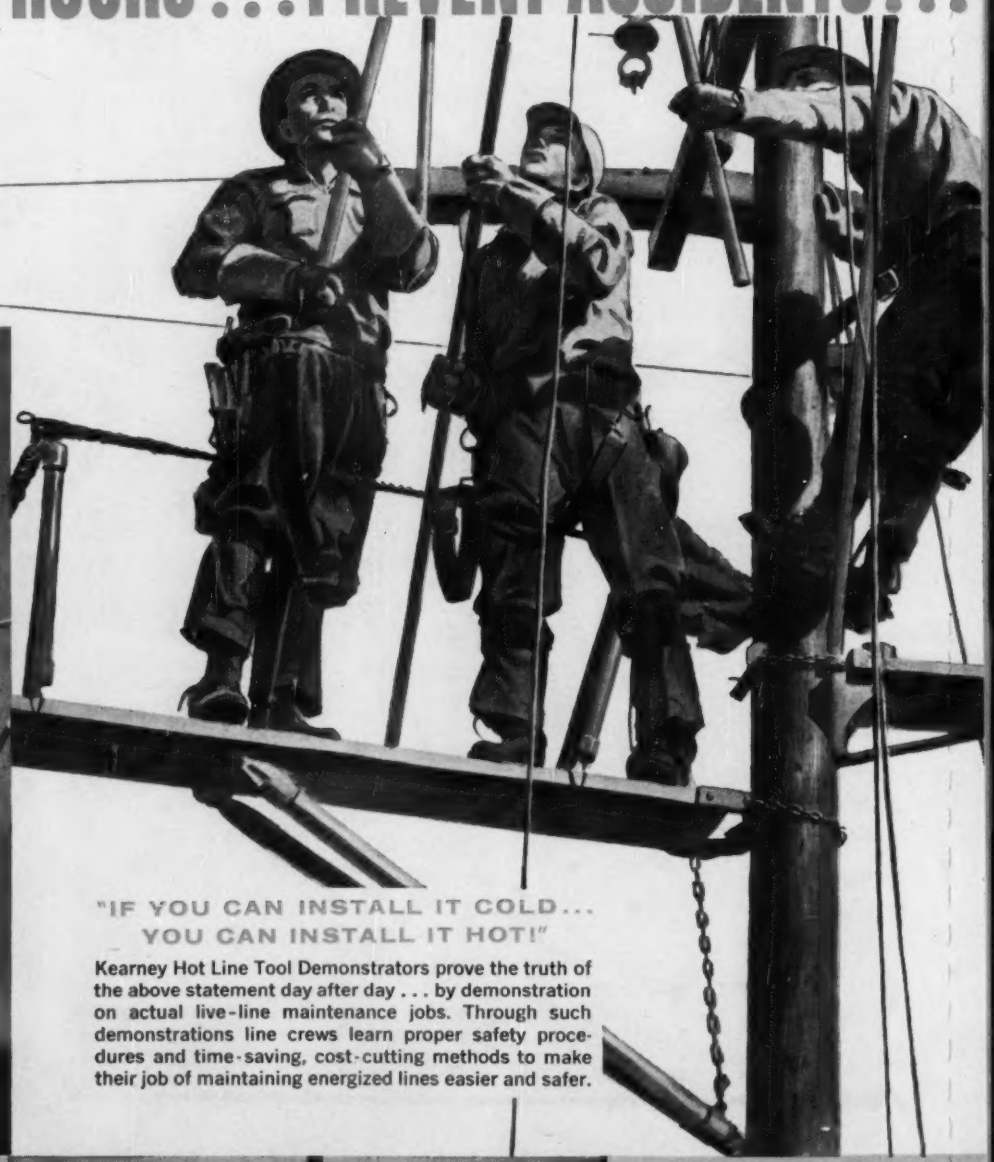
Kearney Hot Line Tool Demonstrators offer line crews new ideas and methods to...

SAVE MAN-HOURS...PREVENT ACCIDENTS...



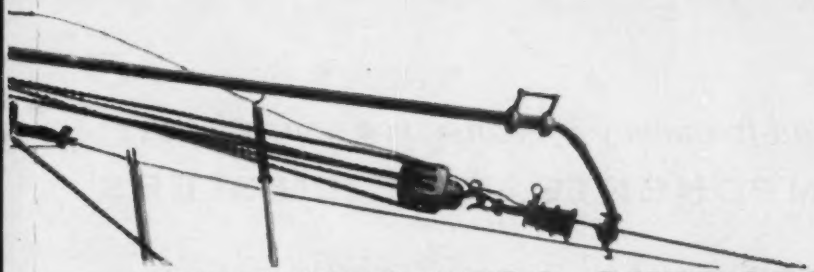


"IF YOU CAN INSTALL IT COLD... YOU CAN INSTALL IT HOT!"

Kearney Hot Line Tool Demonstrators prove the truth of the above statement day after day . . . by demonstration on actual live-line maintenance jobs. Through such demonstrations line crews learn proper safety procedures and time-saving, cost-cutting methods to make their job of maintaining energized lines easier and safer.

"On the job" demonstrations help solve spot problems and introduce new methods to line crews which can be used to advantage over and over again . . . to reduce costs, insure reliable operation and improve safety standards.

"We teach something, we learn something . . . everytime out"... says Clete Brewer, Chief of Kearney Demonstrators. This sums up the attitude of Kearney men in the field, explains why they are well-regarded by line crews everywhere.



....STOP NEEDLESS OUTAGES

Even experienced line crews can benefit from the specialized knowledge of Kearney Hot Line Tool Demonstrators. Their background and experience in all phases of rigging, hot line maintenance, and compression connector installation techniques fully qualifies them to assist in training line crews in improved methods to shorten installation time... prevent costly de-energizing of lines... and improve safety conditions.

Kearney Hot Line Tool Demonstrators... are your only single source of complete information on compression connector installation and hot-line maintenance techniques!

Kearney... and only Kearney... manufactures both a complete line of hot stick tools **and** a complete line of compression connectors, tools and dies. The completeness of these two lines is part of Kearney's planned program to provide power companies with a fully integrated selection of equipment to safely accomplish any phase of hot line work... without interruption of circuit continuity or service to customers.

If you would like to arrange for Kearney Demonstrator Service consult your Kearney Sales Representative. Adequate advance notice is necessary, of course, to permit proper planning and scheduling.

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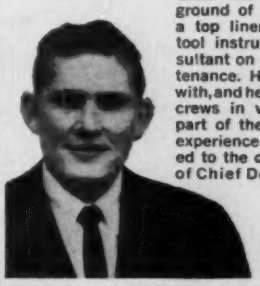
513

Hot stick schools conducted by Kearney Hot Line Tool Demonstrators keep linemen up to date on new installation and maintenance methods... new tools and equipment... new rigging techniques... and new ideas being used to advantage by line crews in other areas.

Chief Demonstrator Clete Brewer and his staff...

... cover the country. Kearney Demonstrators are available for help in training line crews or for consultation relating to specific job problems anywhere in the U. S. Each man is a well-qualified veteran with many years of past experience as a top lineman.

Chief Demonstrator Clete Brewer



Clete has a wide background of experience as a top lineman, hot line tool instructor and consultant on hot line maintenance. He has worked with, and helped train, line crews in virtually every part of the country. His experience is ideally suited to the demanding job of Chief Demonstrator.

CARL JONES

DICK TASKER

JIM MONARSKI

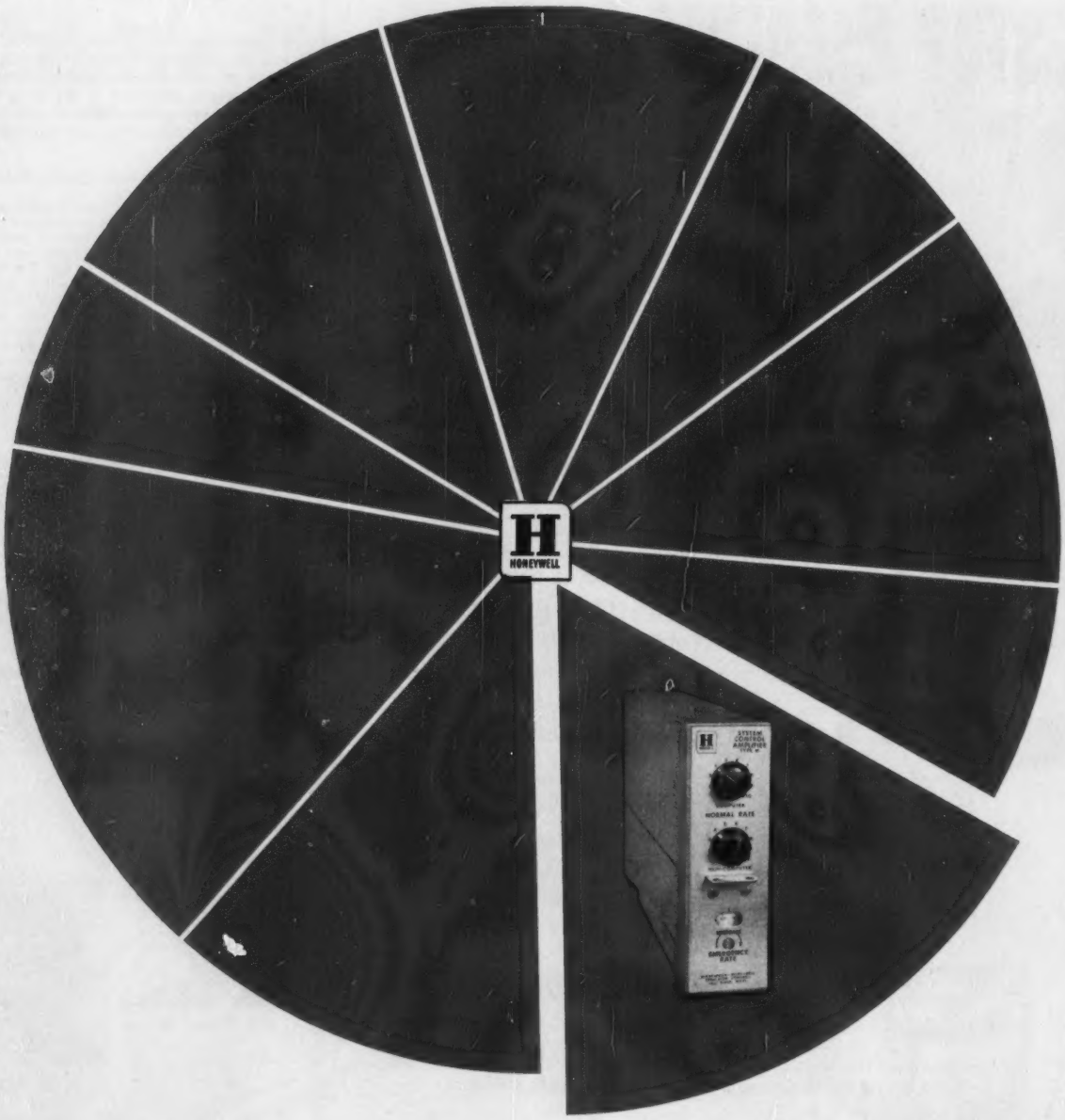
BOB DALE

BERT ROSE

"WHITEY" KOHLER

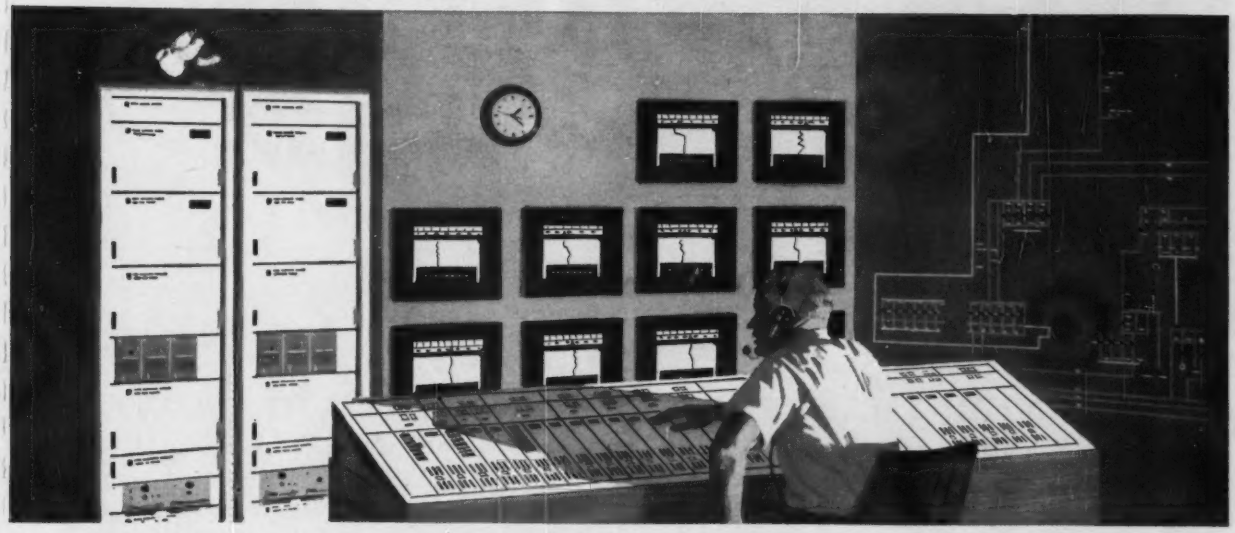
Only Honeywell's new load-frequency system gives you all three:

SOLID-STATE COMPONENTS, RATE LIMITERS



HEART OF THE SYSTEM is this transistorized control amplifier. One basic amplifier performs various computing, measuring, alarm and control functions. Speed of response is easily changed with the turn of a knob. Six amplifiers like this can be mounted in a single standard 19-inch relay rack.

AND COMMAND ACTION



Meet power demands precisely and cut generating costs with Honeywell's new load-frequency control system. It introduces solid state techniques that bring new reliability levels and new performance flexibility and sharply reduce maintenance.

Major components: High-speed, transistorized telemetering equipment transmits tie-line loads to the dispatcher and the command signal to generating stations. Control amplifiers perform computing, measuring, control and high and low alarm functions. Governor motor actuators control generator loading in accordance with command signals. Rate limiters, independent of the control system, hold generation changes within prescribed allowances. Incremental loaders apportion generation on an economical basis.

Easy maintenance: All components are of interchangeable, plug-in, modular design, and are easily accessible while the system operates. Except for relays, *there are no moving parts in the entire system.* Slidewires, motors, gear trains, and vacuum tubes are eliminated. Use of transistors and other solid-state devices throughout cuts space requirements in half and drastically reduces heat buildup. All critical test and calibration points are compactly packaged in a single module, to provide a centralized test area and further simplify maintenance.

Honeywell's new load-frequency control system is a development of first importance in the power industry. For advanced systems, you can add the new Honeywell 290 industrial digital computer to mastermind the system and simultaneously compute cost data for interconnection billing. Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Pottstown, Penna. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell

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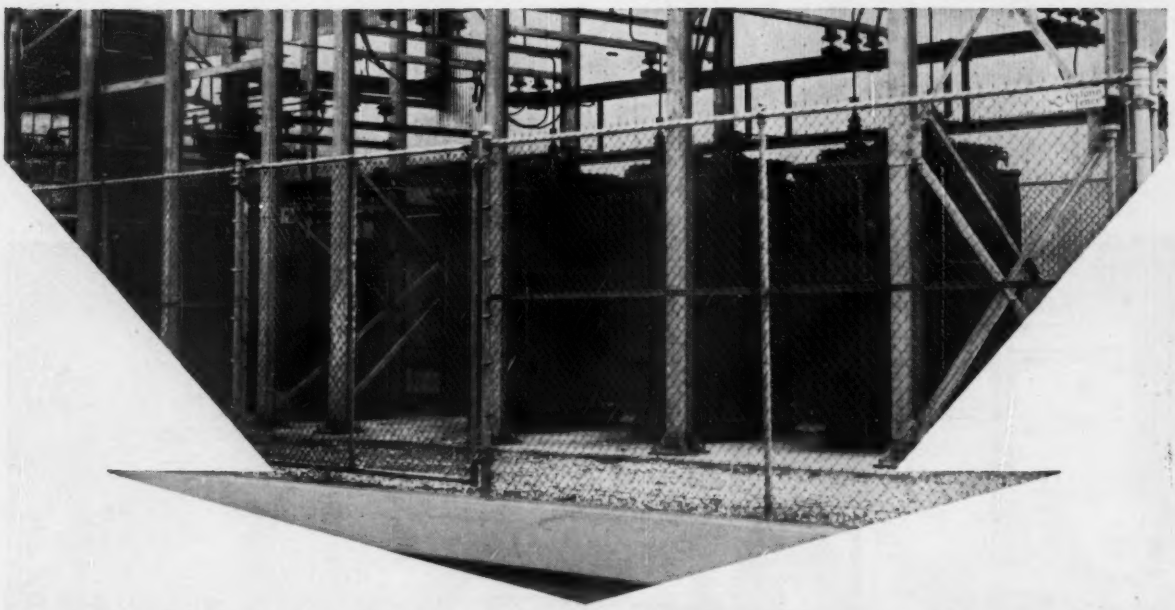
HONEYWELL INTERNATIONAL Sales and Service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



SIX WAGNER® TRANSFORMERS PROVIDE THE POWER

Here are six Wagner® transformers with a full-time job: providing all the power needed by a new electroplating line that produces tin plate for Granite City Steel Company.

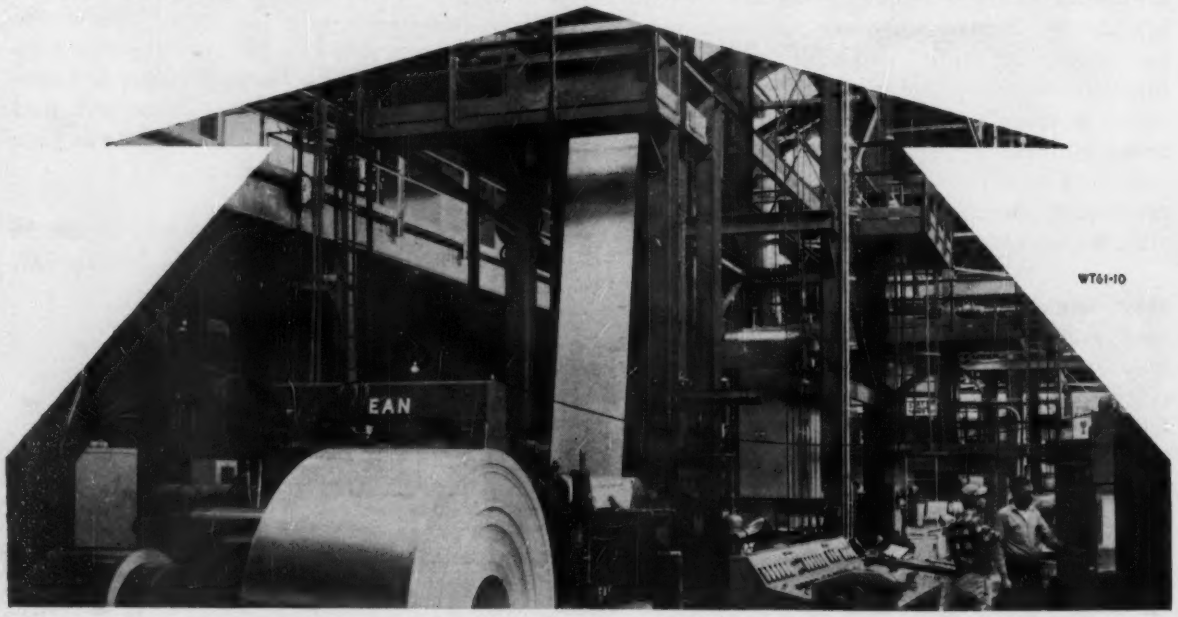
Three of the six supply power to motor-generator sets which convert to DC for variable speed drives, and to plating generation equipment and other major equipment drives. They are all 1667 kva, single phase, 60 cycles, 7200/12470Y to 2400/4160Y volts transformers.

The second set of three transformers are all 500 kva, single phase, 60 cycles, 7200/12470Y to 240 x 480 volts. They supply power for auxiliary pumps, etc.

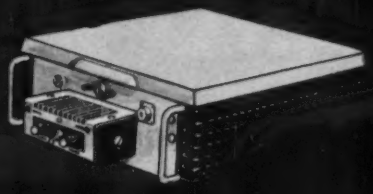
All six are of the latest design . . . have wound cores of cold-rolled oriented grain steel. Their performance stability is outstanding. They're built to be trouble-free . . . built to provide all the power the plating line needs. Wagner transformers are designed to provide all the power you need, too. Your Wagner Sales Engineer can show you how. Call him. Soon.

Wagner Electric Corporation
6456 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

FOR GRANITE CITY STEEL'S NEW TIN PLATING LINE



VALUE-PACKED



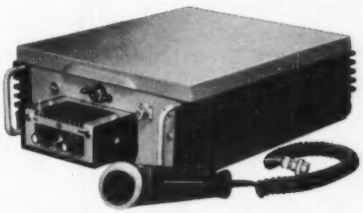
Wisely used transistors enhance the value of RCA "LD" 2-Way Radio and give it built-in dependability

In designing this efficient new "LD" equipment, RCA engineers wisely gave special consideration to the transistor. Only "stock" transistors capable of being serviced with existing test equipment and techniques are used—and only in circuits where they do the best job in cutting battery drain. Tubes are used where they can stand up under high temperatures, heavy voltages—jobs that tubes do best.

As a result the "LD" is not OVERtransistorized, is compact, yet accessible, miserly in power consumption yet value-packed to pack a punch in performance.

Leave the radio on when engine is off—battery drain is negligible. Use it on the roughest roads—transistors and sealed circuits give added assurance it can take it under gruelling conditions.

Specify the RCA "LD" and you can be sure it will stand in back of your endorsement. Lease or purchase plans available. RCA authorized service available. Ask your RCA Representative for complete descriptive literature. Or mail coupon below.



The Most Trusted Name in Radio

RADIO CORPORATION OF AMERICA

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Telecommunication Center, Dept. XC-45
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☐ Please send me FREE literature on the new RCA Transistorized "LD" Mobile Radio.

☐ Have RCA Communications Specialist contact me and explain why this is today's best value in 2-way radio.

NAME_____ TITLE_____

COMPANY_____

TYPE OF BUSINESS_____

ADDRESS_____ PHONE_____

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Rockbestos Silicone Rubber

	POWER CABLE	CONTROL CABLE	APPLIANCE and FIXTURE WIRE
Voltage	600 and 5000 volts	600 volt	300 and 600 volt
Operating Temperature	125°C	125°C	150° and 200°C
Size Range	600V: #14 AWG to 500,000 CM 5000V: #8 AWG to 500,000 CM	#14 — #9 AWG	150°C: #22 to #18 AWG — 300 volt #22 to #10 AWG — 600 volt 200°C: #18 to #12 AWG — 600 volt
Construction	**Conductor** — Tinned copper, stranded **Insulation** — Silicone rubber **Covering** — Asbestos braid	**Conductor** — Tinned copper, stranded **Insulation** — 3/64ths silicone rubber, glass braid, color coded **Covering** — Cable tape, asbestos braid. Also available in galvanized steel, aluminum or bronze interlocked armor	**Conductor** — Tinned or nickel plated, stranded or solid **Insulation** — Silicone rubber **Covering** — Glass braid
Applications	Power wiring in high ambient temperature locations. Allows the most efficient utilization of the conductor. Satisfactory for installations in wet or dry locations.	Recommended where control or signal circuits are exposed to high ambient operating temperatures... steel mills, power stations, automotive, cement and glass plants.	For wiring of high wattage units, such as lighting fixtures, clothes dryers, sun lamps, stoves, electronic equipment, water heaters, ovens, and other apparatus.

Wire & Cable Selector

APPARATUS and MOTOR LEAD WIRE	LIGHTING WIRE
600 volt	600 volts
200°C	125°C
#20 to 4/0 AWG	#14 to #8 AWG
Conductor — Tinned copper, stranded **Insulation** — Silicone rubber **Covering** — Glass braid	**Conductor** — Solid tinned copper **Insulation** — Silicone rubber **Covering** — Glass braid
For leads to motors and transformers in high temperature locations. Stands up excellently under varnish dip and bake processes.	For lighting circuits in high ambient temperature locations.

Rockbestos Silicone rubber cables give you these outstanding advantages:

- excellent heat resistance 125°C-200°C allowable conductor temperature
- flame resistant—slowly forms non-conducting ash maintaining circuit integrity
- corona and ozone resistant
- maintains flexibility from —130°F to +500°F
- excellent resistance to oil, solvents, fuels and chemicals
- excellent electrical properties

ROCKBESTOS WIRE AND CABLE CO.
division of **CERRO CORPORATION**
Nicoll and Canner Sts., New Haven, Conn.

Gentlemen:

I would like to know more about the unique advantages of Rockbestos Silicone Rubber Wire and Cable. Please send me the following:

- ☐ The Rockbestos Silicone Wire & Cable Catalog.
- ☐ A sample of your silicone rubber wire.
- ☐ Please have distributor or salesman call.

Name_____

Company_____

Address_____

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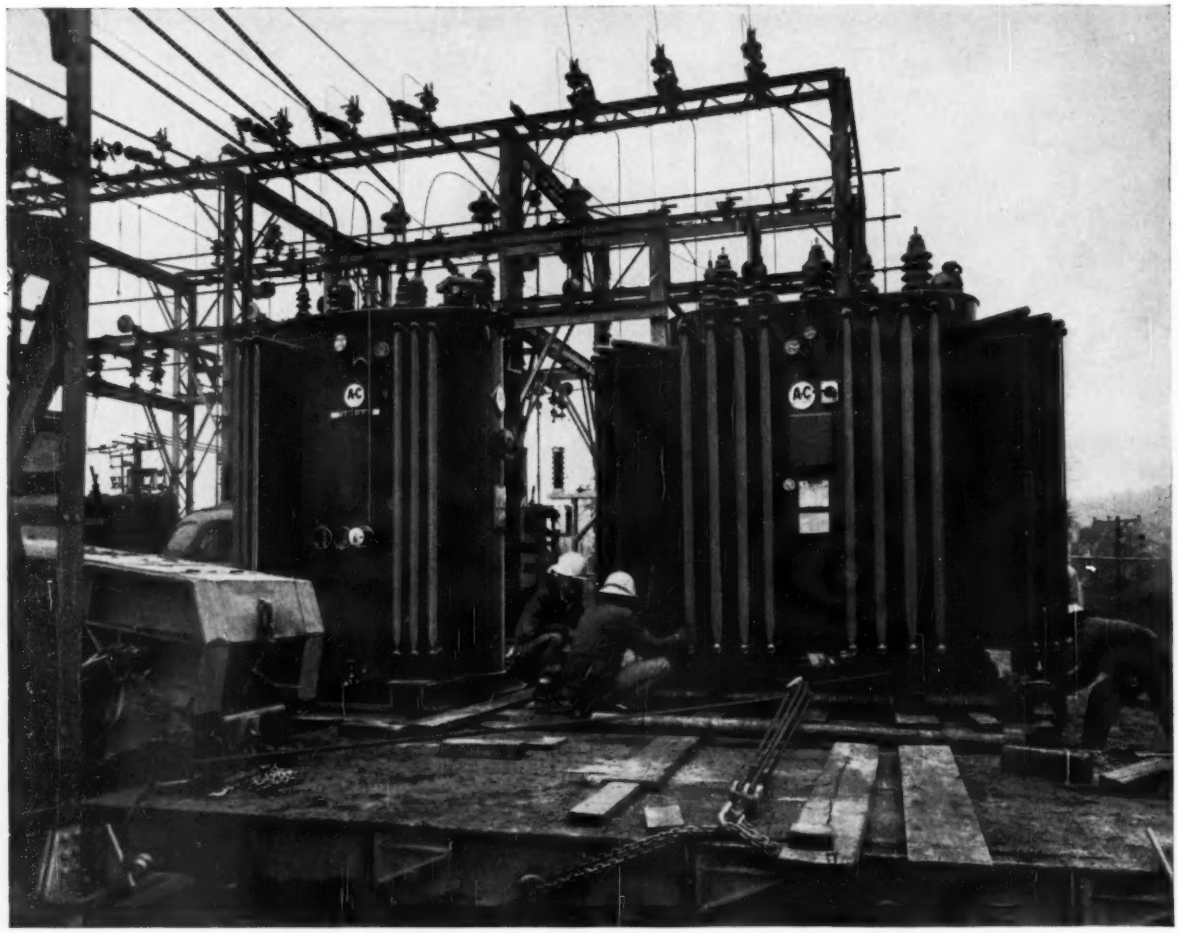


New small power transformer increases station capacity from 2500 kva to 5000 kva with minimum alteration.

With new low-silhouette power transformer...

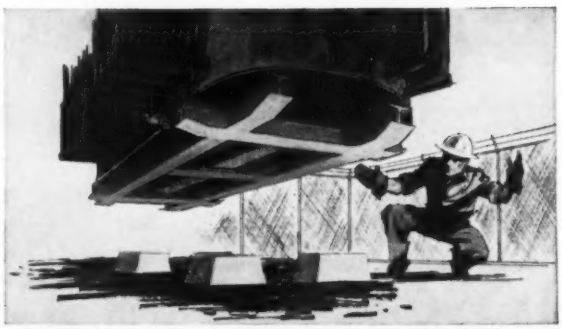
100% more capacity without raising "overhead"

West Penn Power Company installed this compact new A-C 5000-kva transformer to replace an existing 2500-kva transformer without raising the overhead structure!

You too can solve rising substation load and space problems.

Now A-C units can replace your old transformers — deliver as much as a 30% increase in kva without any increase in unit size or weight! You never need alter your base mounting (no weight increase) or your overhead structure (no height increase).

These units, offered in 7500 kva, 69 kv and below, feature reduced losses, decreased exciting current and lower noise level. *Call your nearby A-C office for details or write* **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1438



New base design, reduced transformer weight cut foundation size and cost. No external tank bracing to catch dirt. Clean design makes painting easy.

Editorial Comment

JULY 17, 1961

Cost Issue on Upper Colorado Lines Can Be Resolved

A House Appropriations Subcommittee, within the next week or two, is scheduled to decide whether to go along with the Administration request for money to begin the $187-million federal transmission network for the Upper Colorado Storage Project. The proposal, if it gains Committee approval, will come up for full floor debate in the House and later in the Senate.

The five investor-owned utilities in the Upper Colorado storage area supported construction of the federal generating projects in the area and as early as 1954 offered full cooperation in transmitting the power from the federal projects to preference customers. In October 1959 these utilities presented a comprehensive plan for wheeling power from these projects to preference customers.

The present Commissioner of Reclamation, who is responsible for building the generating projects and securing needed transmission facilities, has acknowledged that the investor-utility proposals satisfy all requirements, except that the transmission costs would be higher than for an alternate federally-constructed network.

The investor utilities contend that their plan is more economical than any alternate federal plan which would do the same job—that project power rates could be same to preference customers as under a federal plan—that $137 million of the government's original investment then would be saved for other purposes.

This issue on costs can be resolved if a Congressional Committee is willing to assign a competent and objective staff to subject the two opposing plans to a rigorous and fair comparison.

Can an Editorial Change the Weather?

On those rare occasions in the past when we've had the temerity to comment or complain editorially about the weather, our words have turned out to be ill-timed and ill-advised. This was mainly because the weather changed drastically between the time we wrote the editorial and the time you read it.

With that firmly in mind, here we go again.

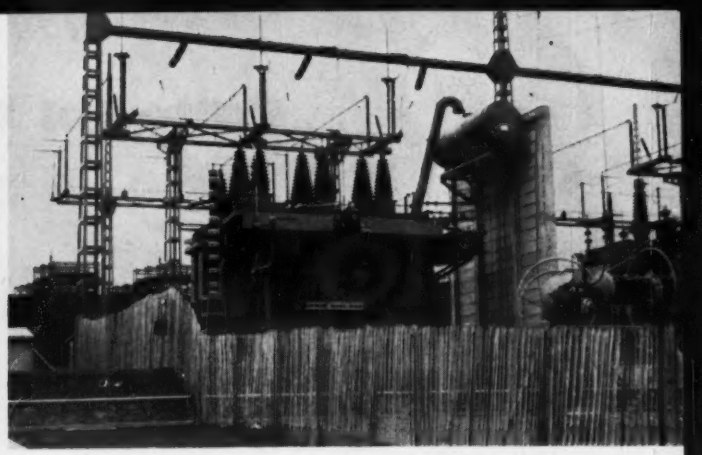
The weather across the nation, some areas of course excepted, has just been too mild this spring and early summer to mean good utility business.

Despite definite pickup of the over-all economy, kwhr sales increases over the same week last year have been showing disappointingly tiny increases. The industrial load pickup, which definitely can be seen, is being partially offset by lower air conditioning kwhr sales.

This isn't helping our forecasts a bit. It's only making us more aware of how temperature-sensitive utility load is becoming.

Yep. We're one of the few complaining about this beautiful, mild weather. Now we'll sit back and see if this editorial does any good.

FRENCH CABLE SHIP Ampere paid out cable from its position 1,000 yd offshore. Spherical plastic floats were used



RECTIFIER TRANSFORMER on the French side is rated at 232/86.3 kv, 97.5 Mva. It was manufactured by Alsthom

Channel Crossing Splice Completed

J. H. M. SYKES, Overseas Engineering Correspondent, London

After several delays due to adverse weather and tidal conditions, the $12.5-million English Channel dc cable was completed by the mid-Channel splicing of the English and French cables at the end of June.

The link, to be operated at 200 kv dc (100 kv positive to ground and 100 kv negative to ground), will carry 800 amp to provide a power transfer of 160 Mw. The French end of the ac/dc conversion equipment is complete, but the British end has lagged behind because of right-of-way problems on associated 275-kv overhead lines. It is expected that current will flow between the 29,000-Mw Central Electricity Generating Board system in Britain and the 40,000-Mw system of France and her electrically-interconnected neighbors by the end of the year.

The link comprises two cables, go and return. Because the British Admiralty insisted that interference with ships' compasses by the magnetic effect of the dc be minimized, the cables had to be laid not more than 10 ft apart.

The route of the cable from the converter station at Echingen, a suburb of Boulogne, France, to the beach at Le Portel, then across the Channel to Dungeness, England, and on to the converter station at Lydd is about 34 miles in all. About 8.3 miles of this consists of land-laid cable at the two ends with the remainder submerged in the Channel. (See map, EW, Aug. 1, 1960, p 28.)

The cable is of the impregnated-paper, solid type. The two 17-mile lengths laid out from England and those from France were designed to meet a common general specification, but they differed slightly in detail.

The British ends of the cable were made by Associated Electrical Industries Ltd and British Insulated Callenders Cables Ltd. Four makers were involved on the French side: Les Trefileries et Laminoires du Havre, Societe Alsacienne des Constructions Mecaniques, Forges et Ateliers de Constructions Electriques de Jeumont, and Les Cables de Lyon.

The cable is about 2.78 in. overall dia. The copper section is 0.553 sq in. (French cable) and 0.525 sq in. (British cable), but these sections are increased to 0.925 sq in. for the land-laid lengths at each end.

The paper insulation is 0.29 in. thick, and the lead sheath is 0.098 in. thick. The polyethylene sheath, 0.314 in. thick, is provided for anti-corrosion purposes, and over it there are (on the French cable) 28 armoring wires, each 0.236 in. dia.

Weight of the English cables is 39 lb per yd in air and 28 lb per yd in sea water, the two submarine half-lengths weighing about 1,200 tons in all.

The cables were tested at 250 kv dc before laying, 225 kv when on the ship, and 200 kv after laying and splicing. These figures are conductor-to-ground, for which the nominal working stress is 100 kv. The depth at which the cables are laid reaches a maximum of 33 fathoms (198 ft).

The French ends were laid first on May 23, after several false starts due to bad weather. The 2,247-ton government cable ship Ampere was anchored about 1,000 yd off shore at Le Portel, and the two cables were lashed together and laid out over the bow sheaves. Spherical plastic floats about 3 ft dia were attached to the cable every 10 yd.

A winch line had been led out from shore, and the cables were slowly drawn out of the ship. The very strong current immediately caused the cable to bow out into a great arc. Frogmen and cable hands in small boats brought the cable back into line before the floats were detached and the cable allowed to sink. Laying then proceeded at 3 mph to mid-Channel.

The two British cables were laid on June 9, again after several false starts, using the Central Electricity Generating Board's 2,700-ton converted collier, Dame Caroline Haslett.

Splicing, which took 44 hr, was carried out on June 20 on board the Ampere. It was necessary to find a two-day calm for the splicing, because rough seas—with the cable ends firmly clamped—would have strained the lead sheath.

The conversion equipment, all supplied by ASEA Ltd, of Sweden, consists of (at each end) two tube bridges, each with a by-pass tube in addition. Each bridge consists of six tubes, weighing about 5 tons

each. Four anodes are mounted in porcelain containers on top of the steel cathode tank. Each tube with its ancillary apparatus stands about 10 ft high and is about 6 ft wide and 10 ft deep. Each anode will carry 200 amp, and each anode container is fitted with potential grading electrodes along its length, these latter connected externally to a potential grading network. The tubes are continuously exhausted.

Each tube group provides 100 kv dc and is insulated from ground. The two groups in series provide 200 kv for the cable link. The series connection is made through a smoothing reactor, the mid-point of which is grounded. But only one end of the cross-channel link will have the ground connection applied at any time. If a tube should fail, the bypass tube will take over automatically allowing the current flow to be maintained at reduced level.

At the French end, the main ac connections are made through two 232/86.3-kv 97.5-Mva transformers made by Alsthom. At the British end, the connections are through two 284/83.6/33-kv, 95/95/65-Mva Fuller Electric transformers.

Transformers at both ends are connected so that one is in star-star and the other in star-delta. This arrangement gives a displacement of the secondary voltage by 30 deg between the two, and the tube bridges operate on a 12-phase system, reducing ripple and harmonics.

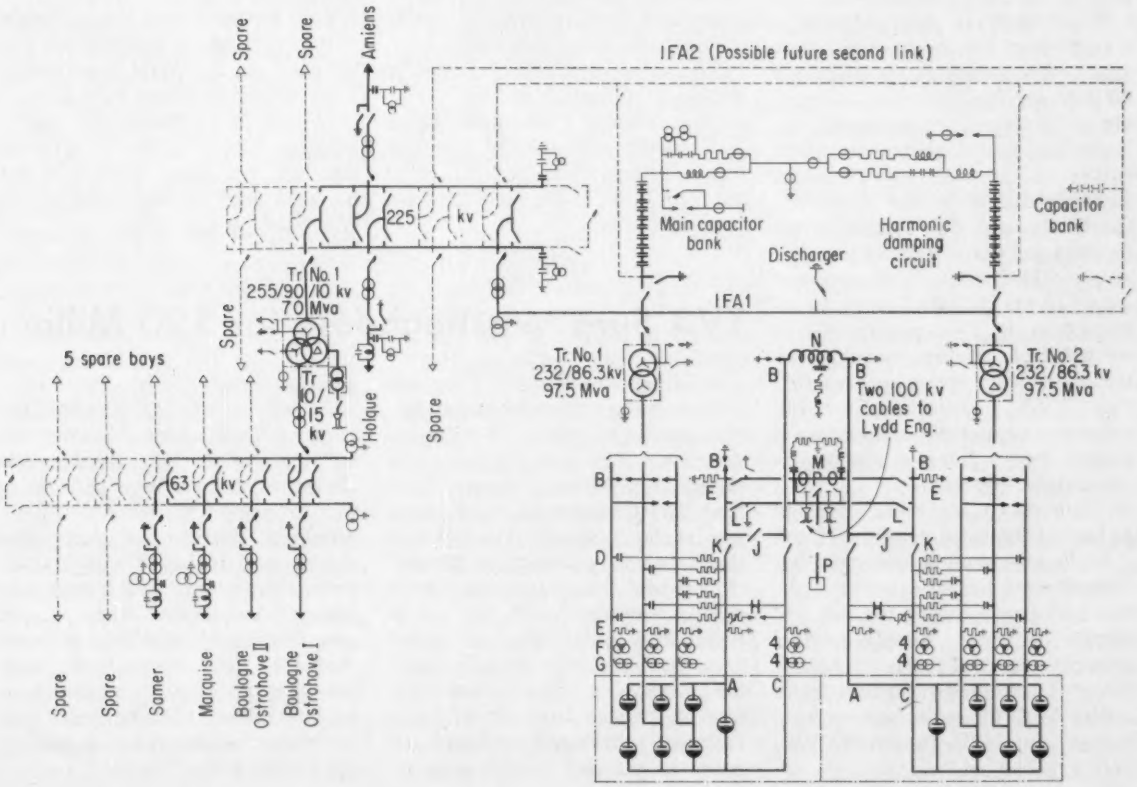
The difference between the British and French transformer arrangements is due to the different forms of connection adopted for large capacitor banks which provide reactive power for converter operation and filter out harmonics which might cause disturbances in the ac networks. At the British end, the capacitor bank is connected through the tertiary winding of the transformers, while at the French end it is connected directly to the 225-kv system, providing 50 Mvar.

Three-phase lightning arresters are connected across phases at the input to the tubes, and other lightning arresters protect dc connections. The dc output connections are provided with damping circuits.

With the completion of the French substation, full-scale load tests are being made on a back-to-back basis, the two tube groups feeding into each other.

DC Converter Equipment at the French End of the Cross-Channel Cable

A—Anode
B—Lightning arrester
C—Cathode
D—Damping circuit for tubes
E—Voltage divider
F—Isolating transformer for grid control impulses
G—Isolating transformer for auxiliary supply
H—Non-linear resistance lightning arrester
J—Shunting isolator
K—Isolators for tube groups
L—Reversing isolators
M—DC damping circuit
N—DC reactance
O—Cable isolators
P—Maintenance device to provide 100 kv on cables



Hanford Power Proposal Nears Vote in Congress

Showdown would come on Van Zandt amendment to strike NPR provision from Atomic measure; outcome closely watched by electric industry

JAMES E. VAN ZANDT

Congress moved toward a showdown vote on the controversial Hanford New Production Reactor (NPR) power facilities late last week.

The House was slated to vote Thursday afternoon on an amendment which would strike the section providing for the NPR power facilities from the Atomic Energy Authorization bill. The amendment was to be offered by James E. Van Zandt (R-Pa.), a member of the Joint Atomic Energy Committee and a leader of opposition to NPR.

While investor-owned electric utilities made no more than a token appearance at hearings on the NPR power facilities, interest in the industry has heightened during the past few weeks as the issue has been brought to public attention.

Rep William H. Avery (R-Kan.), a member of the Rules Committee, took a few swipes at the proposed NPR power facilities prior to opening of the formal debate on the bill. Referring to a statement made earlier in the week by President Kennedy that he would like to see the Tennessee Valley Authority "go forward and not rest on its laurels," Avery said that the NPR proposal would fit the Atomic Energy Commission in the TVA pattern. "Here we will have another monster," he told the House. Avery also asserted that TVA had originally been created as a water resource and flood control agency, but was now primarily a power agency.

While close observers hesitated to predict the outcome of the House vote, there was some indication that opposition to the NPR power facilities had grown during the last few weeks. A clear, sharply worded minority report of the Joint Atomic Energy Committee was credited with setting forth the main issues arising out of the NPR proposals (EW, July 3, p 28).

The floor battle to a degree reflected the sharp controversy that has been taking shape on the Hanford project during the past few weeks. Just prior to the House debate, the House Republican Policy Committee announced its formal opposition to the $95-million authorization item for the Hanford power facilities. This was believed to be partly in recognition of a large number of letters and phone calls from constituents expressing opposition to Hanford.

Numerous newspaper editorials from many parts of the country had also opposed the power project. Also among the opposition were the two large business associations, the National Association of Manufacturers and the U. S. Chamber of Commerce; many Eastern business firms; coal workers; investor-owned utilities; and many individuals.

This opposition rallied around a five-man minority of the Joint Atomic Energy Committee which had sharply opposed the Hanford power authorization and had written their views in the report accompanying the bill.

Support for the Hanford power facilities came mainly from the public and cooperative power groups and the Kennedy Administration. The influence exerted by the various Administration officials was formidable.

Sen Henry Jackson (D-Wash.), who originally proposed the dual-purpose reactor and has pushed the generating facilities, will lead the fight when the bill reaches the Senate. Jackson also can count on the full backing of his Democratic colleagues on the Joint Committee, Sens Clinton P. Anderson (D-N. M.), Albert Gore (D-Tenn.) and John Pastor (D-R. I.).

Date for the Senate consideration of the NPR power facilities has not yet been set, but could come within a few weeks. Hearings have already been held in the House for appropriations relative to the NPR power facilities, but these funds will not be voted until the authorization bill is cleared by Congress.

TVA Sues Westinghouse for $20 Million

Westinghouse Electric Corp has denied charges that 16 steam turbine generators sold to TVA proved defective. The charges are contained in a $20-million suit TVA filed in Chattanooga last week against the company. The suit says that "the many defects in the machinery and the consequent service outages, together with the operational and load limitations placed upon the machine by the defendants, have resulted in excessive fuel costs, loss of revenue from power sales, extensive repairs and additional expense to plaintiff in obtaining replacement power."

In answer, Westinghouse said the units for the Kingston, Shawnee and Gallatin stations "are efficient machines which have been performing well for years. . . . When originally proposed, fourteen of these machines were to be of a highly advanced design and of an unusually high efficiency rate. After . . . it was determined that they did not meet (this rate) Westinghouse took the necessary steps to modify these turbines. Their efficiency rates now are within 'test accuracy' of meeting the specified rate."

TVA Cuts Rates; EEI Replies

Investor-owned utility reaction to a Tennessee Valley Authority announcement of a new lower rate for residential and commercial users last week was quick and pointed. TVA, in a White House ceremony honoring the 100th anniversary of the birth of the late Sen George W. Norris (R-Neb.), said the "Norris Centennial Rate" may be adopted by any of the 155 locally-owned systems purchasing TVA power.

A sharp statement by Edison Electric Institute President Philip A. Fleger attacked the system on which TVA bases its rates. Fleger's statement, issued at EEI headquarters in New York, said in part:

"The Edison Electric Institute, representing investor-owned electric utility companies, recently completed a study of the TVA power business in which two adjustments were made; one, to charge TVA's power operations with taxes comparable to those paid by electric companies; and, another, to charge for the use of funds invested in such power operations, comparable to those charges paid by electric companies which are financed in the free market. If TVA and its municipal distributors were to pay their share of taxes and market costs of money, rates to their customers would have to be raised 46%. If this were done, electric rates in the TVA area would then be about the same as rates paid by customers of the electric companies operating under similar circumstances."

The new TVA rate schedule includes residential and commercial rates below those previously established as the lowest charged by the distribution systems. Wholesale rates charged the systems by TVA for bulk power will not change.

The residential rate schedule is: 100 kwhr per month at 2.0¢ per kwhr, the next 150 kwhr at 1.0¢ per kwhr, the next 650 kwhr at 0.4¢ per kwhr, and over 900 kwhr, 0.675¢ per kwhr.

The new schedule makes possible a reduction of about 8% from the present lowest level for commercial users but can provide more significant savings for farm and home customers. A dwelling or farm using 500 kwhr per month would pay $4.50 a month or $54.00 per year, as compared with $6.90 a month or $82.80 a year under the highest rate in the TVA service area, and with $5.10 a month or $61.20 a year under the previous lowest rate schedule.

The rate cut is the first general reduction on TVA-supplied systems since 1944. No change in street lighting rate schedules is anticipated, and the previous lowest street lighting rate will be incorporated into the new fourth general rate grouping.

Public Works Bill Delayed in Committee

The mammoth public works appropriation bill for fiscal 1962, which has already begun, is still delayed in the House Appropriations Committee, primarily because of the hospitalization of chairman Clarence Cannon (D-Mo.) who broke several ribs in a fall at his home.

The House committee was delayed initially by the record volume of testimony presented in this year's secret hearings, and the inability to get into shape for discussion before Congressmen broke loose for their traditional July 4th holiday and trips. The committee's hearings, recently released to the public, will fill approximately twice the space of previous years.

Bonneville Wants Lines

As part of the bill, Bonneville Power Administration is asking for $410,000 to start work on a transmission line from the proposed Hanford nuclear power plant to Puget Sound. The line would cost $20.8 million ultimately. It would include 25 miles of 230-kv line between Hanford and Vantage, Wash., 125 miles of 345-kv line between Vantage and Covington, Wash.

Bonneville also is seeking an additional $3,300,000 this coming year to build a 230-kv line to the new Anaconda steel mill at Anaconda, Mont. The Anaconda connection would cost $17.4 million eventually: one leg running to the plant from the Hungry Horse-Noxon Rapids area, the other leg from Hot Springs, Mont., to the plant.

Upper Colorado lines have been juggled still more by the Bureau but at no increased ultimate or fiscal 1962 cost. Two lines would be added in Utah, under the latest revision: one 138-kv line from Flaming Gorge dam to Hyrum and Springville, Utah; another 138-kv line extending north from Sigurd to Gunnison and Fillmore, Utah, with an extension westward to Paragonah and St. George, Utah.

A previously planned 115-kv line from Flaming Gorge dam to Pilot Butte has been dropped, and an alternate, shorter 115-kv line would be built from Craig, Colo., to Sinclair, Wyo. A 230-kv line would be built eastward from Pueblo to Limon, Colo.

Still indefinite are the number and size of lines between Glen Canyon and Four Corners. The Bureau earlier planned to build a single 345-kv line between Glen Canyon and Phoenix, replacing its initial idea of two 230-kv lines.

Pumped Storage Studies Asked

The Corps of Engineers, in hearings, proposed a one-year study of federal pumped storage power projects. And the House committee is expected to recommend $225,000 to carry it out.

Maj Gen W. F. Cassidy, director of Corps civil works, said his study probably would cover 125 reservoirs, mostly in the Ozark Plateau and southeastern US. This would be a general reconnaissance study.

The Bureau of Reclamation also is expected to show an active interest in pumped-storage facilities; and the Southwestern Power Administration is particularly anxious to build such facilities in its area, where SWPA administrator Douglas Wright has estimated there may be up to 5 million kw of pumped-storage capacity available.

Utility Wins Overhead Line Fight

New Jersey Supreme Court upholds PUC's right to decide how power should be transmitted through townships

A recent decision by the New Jersey Supreme Court can be considered a victory for the electric utility industry in the growing controversy concerning underground versus overhead installation of power lines.

The court gave Public Service Electric & Gas Co the go-ahead to continue with the construction of overhead lines along the right-of-way of the Staten Island Rapid Transit Railway Co through the borough of Roselle, near Newark. Roselle had tried to force Public Service to construct the lines underground.

The decision upheld a ruling by the New Jersey Public Utility Commission giving Public Service the right to erect overhead lines. Construction, started in 1956, was delayed while the high court considered an appeal by Roselle and Union County of the PUC ruling.

Roselle first blocked construction by amending its zoning ordinance to require a utility to obtain a permit before erecting overhead power lines. The PUC ruled in favor of Public Service in this matter of finding that the overhead line was "necessary for the service, convenience or welfare of the public."

Roselle then battled Public Service on a new front. It adopted a police power ordinance in February, 1960, providing that all power lines carrying more than 33 kv must be installed underground.

The state Supreme Court also upheld the PUC on this count. In ruling in favor of Public Service on the police power ordinance, the court wrote:

"Were each municipality through which a power line has to pass free to impose its own ideas of how the current should be transmitted through it, nothing but chaos would result, and neither the utility nor the state agency vested with control could be assured of ability to fulfill their obligations of furnishing safe, adequate and proper service to the public in all areas.

"The matter is clearly one for board control alone, which it (PUC) has exercised . . . This Roselle ordinance is clearly beyond municipal power."

Roselle had tried to compel installation of underground lines by contending that overhead lines are a hazard to persons and property; depreciate property values; offend by their appearance, and interfere with radio and television reception.

But the court found that "the utmost in safety precautions had been designed into the proposed line." It also ruled that Roselle had not proved its case that property values would drop. There is no evidence that high-voltage lines affect radio or television reception, the court noted in its ruling.

Public Service, in attempting to reach a compromise with Roselle, had agreed to substitute 70-ft-high H-frame structures for the 150-ft steel towers originally proposed.

In commenting on the extra cost of installing underground lines, the court noted that Roselle's own expert estimated that installation of a single underground cable would cost $366,000 more than overhead lines.

The court commented that the territory to be covered by the proposed line has "experienced a phenomenal growth . . ." and that the expansion is expected to continue. It said that a "utility must, in fulfillment of its obligation to furnish adequate service, construct facilities to be prepared to meet the present and prospective demand without fail."

Emphasize Research, CEA Told

With a plea for more research to bolster future electrical development, David Cass-Beggs bowed out as president of the Canadian Electrical Assn at its 71st annual meeting held in Banff, Alberta.

Cass-Beggs was highly critical of the amount of effort which his country has put into new developments in power generation and transmission. Describing the lack of research in the electrical field as "neglect of the future," he said it was doubtful if Canada—or the North American continent—could "lay claim to much in the realm of new ideas or revolutionary design or application.

"Only today," Cass-Beggs said, "are we discussing the higher utilization voltages that have been standard in Europe for 30 years; only now are we beginning to respond to the demand for underground distribution, common in all European cities; to date we have dismissed electrical traction; and only under the pressure of gas competition have we taken a new look at electric space heating."

One problem which emphasized the research situation in Canada, he said, was the future course of electrical system integration. Whatever form the next phase might take, whether regional or national, "it is clear that transmission over longer distances and at higher voltages than we have hitherto attempted will be involved." Cass-Beggs thought that discussion on this topic might focus attention on the advantages of direct current over alternating-current transmission but lamented, "no experience exists on this continent that would be of much value in reaching the necessary decisions."

The departing CEA president also spoke of the importance of the nation's electrical manufacturing industries. Presenting a new approach to possible expansion of Canadian exports of electrical equipment, Cass-Beggs said that if Canada can sell wheat "on an eat-now-pay-later basis," it might be possible to sell electrical equipment on a "pay-as-you-use-it basis."

Taking over the president's chair from Cass-Beggs is H. F. Beique, president and general manager of Quebec Power Co. New vice presidents are R. E. Tweeddale, New Brunswick Electric Power Commission, and H. H. Steede, British Columbia Electric Co.

GEOLOGIST P. FOX demonstrates how pressure against the Nez Perce model causes supporting rock formations to give away and tumble into the gorge

Model Dams Collapse Nicely At Colorful FPC Hearings

In an unusual series of events, Pacific Northwest Power Co has built Nez Perce Dam; and not to be outdone, Washington Public Power Supply System has constructed Lower Canyon Dam—both are guaranteed by their builders to collapse.

PNP says its Nez Perce job will fall—putting Lewiston, Ida., under more than 100 ft of water—because of uncontrollably weak rocks at the site which already are slowly falling into the Snake River Canyon. And it has two experts, Portland Fox and Clifton Livingston, to assure its failure.

WPPSS, however, hasn't had a chance to testify on the certain failure of its Lower Canyon Dam, but something similar is expected to be submitted.

PNP originally filed to build the High Mountain Sheep project, on the Snake River just above its confluence with the Salmon; and at a later date it proposed to build the Lower Canyon project. WPPSS, in an 11th-hour filing, had asked the FPC for permission to build a single, rival dam at the Nez Perce site, downstream on the Snake from the Salmon's juncture.

PNP's Nez Perce and WPPSS' Lower Canyon Dams, by way of clarification, are models. They are being used for illustration in the FPC hearing room in Washington, D.C., where PNP and WPPSS are grinding through rebuttal arguments before examiner William Levy.

PNP still prefers to build High Mountain Sheep—Lower Canyon at a future date—but it built the Nez Perce model to emphasize the position of its experts that any dam at Nez Perce is doomed. (Actually, two of PNP's representatives in Washington, A. B. Martin and his son, built the model in their spare time. A similar model might have cost PNP's rate-payers up to $25,000, if purchased commercially.)

The WPPSS model of Lower Canyon is somewhat overwhelmed by its sophisticated PNP rival. It's smaller, unpainted, lacking in the details of the Nez Perce model. But it has the one essential of the PNP Nez Perce model—it's quite capable of falling down.

PNP had hoped to place its Nez Perce model on the record, but this is rare and Levy followed precedent by forbidding it in the record. Levy stated, "I am satisfied that a three-dimensional model is legally as admissible as a flat or two-dimensional exhibit (such as a map)," but he noted that acceptance of evidence is within his discretion, and the "issue here is purely practical and administration"—in other words, where would the FPC keep it, and how would witnesses not present see it?

PNP attorney Hugh Smith urged acceptance of the model because of the "rather extraordinary" development in the Nez Perce—High Mountain Sheep fight, where a "complete conflict of opinions" between professional men has taken place—particularly over the rock structures at the Nez Perce and, to a lesser degree, at the Lower Canyon sites.

The PNP model lost part of its significance when WPPSS revised its own design plans for Nez Perce (PNP built the model with WPPSS' original spillway and powerhouse locations). But this was made up for in another gimmick added to the model. Possible cleavage planes at the Nez Perce site, along faults, were actually sawed out in the model. Most of these are pegged together for re-assembly. However, six planes along the model dam's east abutment—where Dr Livingston presumes the collapse will originate—are attached with magnets. In a dramatic, surprise move at the hearing, Livingston pushed on the first of these sections, against which the Nez Perce arch would press, and a 15-in. rock slide thundered into the gorge.

The implications and propaganda value of this are hard to estimate. Photographs of the models will be placed in the record.

Not Guilty Pleas Entered In Milwaukee Trust Case

Six manufacturers of pole line hardware have pleaded not guilty to charges of price fixing (EW, June 19, p 49). And a federal judge has granted the defendants 60 days to file motions. The defendants, indicted June 7 in Milwaukee, are McGraw-Edison Co, Oliver Electrical Mfg Co, Utilities Service Co, Joslyn Mfg & Supply Co, and A. B. Chance Co, and Hubbard & Co.

Pres C. H. Linder confers Honorary Membership on TV pioneer A. B. Du Mont . . .

. . . presents Lamme Medal and Certificate for Achievement to MIT's Dr J. G. Trump . . .

. . . and pins AIEE President's Badge on Pres-elect W. H. Chase, Ohio Bell Telephone executive

Summer Meeting . . .

Hears DuMont

TV pioneer sees need for high-type programs which lack sponsor appeal. New president plans push on AIEE relations. Members tell engineering advances at technical sessions

■ The warm drowsy calm of AIEE's Summer General Meeting at Cornell University last week was broken in a fashion that snapped nodding heads erect clear back to the rear seats.

Dr Alan Du Mont, industrialist, television pioneer and long-time advocate of more TV networks, was responding to the Institute's award of honorary membership. Most of the delegates in Statler Auditorium expected a routine acceptance. Du Mont had other plans.

Stoutly maintaining his opposition to government in business, he bluntly called for a fourth television network supported by the government as the only cure for the programming ills and excesses prevailing in TV today.

"I plead for a few million dollars and some men with guts to bring culture and information to the television screen," he said.

"In most cases you have to watch the mayhem, the froth, and the gun fight on Main Street—or you don't watch anything," Du Mont continued. "My reaction has been that of the creator of a Frankenstein. Yet I am here today because I helped make this possible."

Observing that television programming is for the majority and that the finest type, from an informational and cultural standpoint, doesn't get sponsorship from large advertisers, Du Mont faced the alternative squarely:

"I believe that the government of the US is the only possible sponsor for programming of a non-commercial, intellectual and informative type," he said. "We need some sort of separate corporate organization like the British Broadcasting Corp which is completely removed from political pressure," he said, adding, "Publicly owned television is too strong a tool for partisan political use."

Sharing AIEE honors with Du Mont on opening day was Dr J. G. Trump, recipient of the Lamme Gold Medal—one of the Institute's highest honors which is given annually to the member who has shown meritorious achievement in the development of electrical apparatus.

Dr Trump, professor of electrical engineering at MIT, was cited "for meritorious achievement in the design of particle-acceleration and x-ray generators . . . and also for exceptional contributions which led to applications in treatment of malignant diseases." He designed one of the first million-volt x-ray generators used in cancer therapy for Huntington Memorial Hospital in Boston.

In his acceptance remarks, Dr Trump commended the pioneering work being done in Europe with dc transmission of power across the English Channel be-

Propose Federal TV Net to Cure Ills

tween France and England at 200 kv dc and in Russia between Moscow and Donbas at 800 kv dc. He expressed conviction that megavolt particle accelerators had much to contribute in the field.

President-elect W. H. Chase, vice president of Ohio Bell Telephone Co, was inducted into office by retiring President C. H. Linder during the Institute's business session which also saw announcement of ten vice presidents, four directors and a treasurer. Chase, who assumes presidential duties Aug. 1, called for a better-organized, better-coordinated engineering fraternity. He said he hoped to push inter-society relations even further down the road of progress than they have already traveled.

In his final report to the Institute before leaving office, President C. H. Linder said attainment of creative management of our technology has been the principal objective of his administration. In working toward this objective he sought to bring about three things:

- A clearer understanding of Institute goals
- Enchanced efficiency in the conduct of AIEE affairs
- Better inter-society relations.

Linder announced that the Board of Directors has authorized a Committee of Action to lay down a clear concept of the objectives of the Institute and to report to the president. A second task force has been created to locate manpower and make it available to satisfy requirements as officers and personnel of the Institute. A third group or Council of Technical Consultants has been named to monitor Institute operations on a periodic basis in the interest of enhanced efficiency.

Constructive inter-society contact, Linder said, can and should be carried on at the section level. He noted existence of closer relations between IRE and AIEE and said he anticipated further and more constructive relations with "our most important cousin" in the future.

Cross-discipline technical exchange among societies is being maintained and advanced, he said, by such joint operations as the Automatic Control Conference sponsored by AIEE, IRE, ISA and others.

Linder reported that AIEE will move into the new Engineering Center in New York City about September 1. Cost of the move will be approximately $156,000, he said.

Technical sessions before and after the annual meeting ran the gamut from radio to education. Those of interest to utility engineers are briefed below.

EHV Lines and Cables Gain in Capability

Expanding pools focus on 1,000-mile open-wire lines; cable experts scout voltage, capacity limits of UG sections

■ Today's concern with interconnection of large power pools and remote low-cost energy sources has spurred technical and economic exploration of EHV for transmitting large blocks of energy up to 1,000 miles. Engineers from Pacific P&L Co and Westinghouse emerged from such a study with the conviction that extra long distance (ELD) transmission is technically feasible. Their findings were reported by J. B. Ward and D. E. Martin of PP&L, and E. W. DuBois, J. F. Fairman, and C. M. Murphy of Westinghouse.

They started by assuming: (1) complete shunt compensation of the line, with series and shunt compensating elements applied in π configuration; (2) loading and capability based on 30 deg between high-side terminal voltages; (3) terminal power factors held to equal values at the two ends; (4) receiving and sending-end voltages restricted so geometric mean equals nominal line voltage.

Their general conclusions were:

1. Shunt compensation is required to control voltage; economic considerations dictate that it be heavy up to 80% and more.

2. Economic loading is fairly independent of transmission distance.

3. At given loading, unit transmission cost varies almost linearly with distance from 600 to 1,000 miles.

4. Unit transmission cost is essentially independent of number of line sections but a minimum number is dictated by voltage limits.

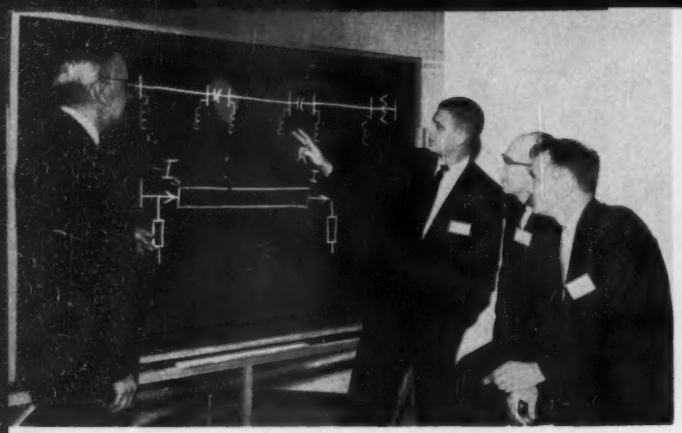
5. Deviations from 30-deg line angle have little effect on optimum transmission cost for given conditions or on optimum loading.

Graphic analysis of field patterns of bundle conductors and their electrostatic properties, undertaken with a digital computer by A. S. Timascheff, Alcan, produced a series of charts that was generally applauded because it permits fast calculation of maximum surface gradients with very attractive accuracy.

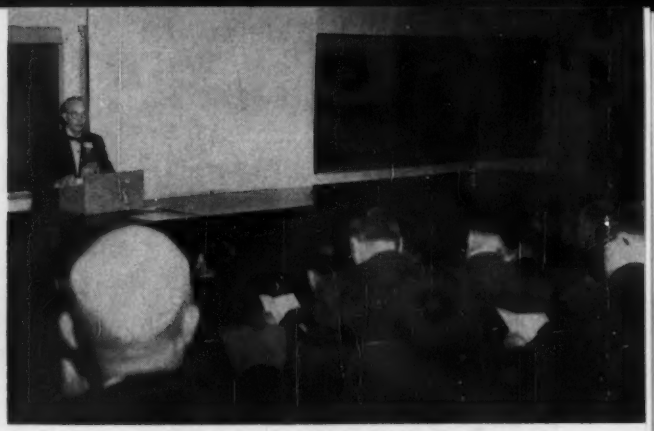
Three papers tackled radio noise from transmission lines.

R. J. Mather and B. M. Bailey, BPA, recommended resort to statistical language. They found that RI follows a normal distribution, also that the only reliable comparison of two or more lines is a comparison of the mean and standard deviation of their RI levels for at least a year. Continuous recording, they feel, is the most practicable means of acquiring necessary data. But random sampling is a reliable method of inferring total characteristics.

Carl Helstrom, Westinghouse, used a simple statistical model of currents and voltages induced by individual corona discharges and from it deduced spectral densities



SCHEMATIC for 1,000-mile, 750-kv line discussed by J. E. Ward, Pacific P&L, and C. M. Murphy, Westinghouse, with E. W. DuBois, Westinghouse, and D. E. Martin, PP&L



INSULATOR CONDUCTOR session finds audience attentive to opening instructions of Chairman F. M. Hull, Detroit Edison, before its authors tackled varied cable problems

of voltages and currents in the line. By comparing results for a short line with those for a long line, he developed a method that predicts spectral densities of a long line from measurements on a short one.

A. K. Abboushi and L. O. Barthold, GE, applied digital techniques to compute relative mean noise levels in fair weather. Their program has been used to estimate minimum conductor sizes for 1, 2, 3 and 4-conductor bundles.

Explore Cable Limits

With transmission climbing steadily into the EHV range, uneasy eyes are being cast at thermal and dielectric loss limitations imposed on cable by existing paper and oil insulation.

A paper by R. A. Tellier, Electricite de France, and J. M. Oudin, Cables de Lyon, at the insulated conductor session analyzed technical and economic factors involved in maximizing an EHV cable in terms of capability. They concluded that 650 to 900 Mw per circuit is at least theoretically possible at 400 kv with buried cables without forced cooling. Higher voltages permit only limited increases in capability. At 600 kv, transmissible power can reach 1,000 Mva under favorable conditions but falls under 500 Mva where soil thermal resistivity is about 120 thermal ohms and the three cables are close together.

There is a limit to maximum voltage, they said, if maximum diameter and working stress are fixed. A 700-kv cable is possible only if working stress is above 200 kv per cm and cable diameter remains 4.33 in. While forced cooling can push back the limit on capability, internal cooling can only be used for short lengths. External cooling is less efficient but allows greater fluid flow and permits longer runs. Transmission of 1,000 Mva at 500 kv seems possible over distances of 1¼ miles using 1,600-MCM conductors.

Experience with the installation of 13,000 ft of 69-kv (75-Mva), aluminum-sheath, high-pressure, gas-filled aerial cable by Long Island Lighting Co (EW, June 19, p 60) led to several recommendations by F. J. Bender, LILCo, and E. J. Merrell, Phelps Dodge. Among these, use of steel stringing blocks of adequate strength was emphasized. Stiffness of the aluminum sheath caused it to bridge some blocks during stringing and concentrate load on others which failed in cascade, crimping the cable.

Trouble with spinning the cable and messenger in the field was also traced to the sheath's stiffness. Although the spinner had been used successfully on heavier lead-sheath cables of smaller diameter, stiffness imposed unforeseen loadings on mechanical parts, causing rapid wear and preventing the spinner from riding the messenger properly. Modifications finally permitted stringing four to five spans a day.

Riser De-rating Overcome

De-rating in risers was overcome with a ventilated, double, riser shield having a labyrinth arrangement that prevents contact with the cable. A patented thermal backfill of unknown composition was installed in one 300-ft buried run in an effort to hold thermal resistivity to 90 ohms, they said.

F. O. Wollaston and K. H. Kidd, International Power & Engineering Consultants, described the design, installation and field testing of special sheath insulation on 60, 132 and 230-kv oil-filled cables in ducts to prevent sheath damage from abnormal voltages during ground faults. Fault voltages of 15 kv between sheath and ground and impulse voltages of 5 to 40 kv were reported on bonded sheaths during switching. Polyethylene jackets were installed to withstand 15 kv and proof-tested with a 2,500-v Megger using 100 megohms per 1,000 ft as a minimum.

Among the discussers, Herman Halperin, Commonwealth Edison, said Chicago experience showed no need for protection against transient sheath voltages in duct cable. But an Ontario Hydro engineer reported surges up to 20 kv when closing cable circuits.

Safety grounding of cable sheaths is inconsistent with effective cathodic protection which calls for high sheath-to-ground resistance. Several schemes that provide enough grounding to prevent excessive voltage rise on sheaths during ground faults but keep dc resistance high enough for cathodic protection were described by S. E. Trouard and M. J. Maier, New Orleans PS. Among these was a new grounding cell consisting of a 4-in. galvanized pipe inside an 8-in. black iron pipe. Space between is packed with a salted mud slurry. When the inside pipe is connected to cable sheaths and the outside one to ground, passage of dc causes the cell to polarize and cut dc flow to a negligible value.

Mine-Mouth Generation Sets System Problems

Four Corners gains stability with braking resistor; Breed cuts overvoltage with reactors

■ Stable transmission of 350-Mw from Four Corners Plant via two 345-kv lines 159 miles to Arizona Public Service Co's 230-kv system at Cholla and one 345-kv line 133 additional miles to Phoenix will be achieved by inserting a 300-Mw braking resistor across the Four Corners bus immediately after a fault is cleared, said W. H. Croft and R. H. Hartley. The resistor absorbs accelerating power which might swing generators out of step despite 30-cycle reclosing. Insertion delay for severe faults is critical, they said, 5 cycles retaining synchronism where 10 cycles permits pullout. But removal can be at will by conventional switchgear.

The 300-Mw resistor will be adequate, they predicted, after Four Corners is boosted to 575 Mw, as the second 345-kv line will be extended to Phoenix and supplemented by 25% of series compensation at Cholla. But when the fourth unit boosts Four Corners to 800 Mw, the braking resistor must be changed to 500 Mw and series compensation raised to 40%, they said.

The difficulties encountered in siting a major power plant at coal fields remote from its load are also illustrated by AEPCo's Breed Plant, said C. F. De Sieno in a paper co-authored by A. Hauspurg. Preliminary estimates proved the plan economical. But its transmission had to sustain a one-line outage without dropping the 500-Mw unit. And subsequently, when the plant reaches 1,000 to 1,500 Mw, its transmission should withstand a double-circuit outage. Accordingly the initial step provides 96 miles of double-circuit single-conductor-per-phase 345-kv lines to a switching station, thence 90 miles of similar transmission to a receiving substation in the load area. The second 500-Mw unit will require a second 96-mile double circuit to the switching station, thence, 100 miles to another receiving substation. Capability of this four-circuit system can be bolstered by series compensation at the switching station to carry a third 500-Mw unit, they said.

Charging current of the initial transmission system, computed at nearly 300 Mvar, could boost Breed Plant's bus voltage over 390 kv during unit outage or cause dangerous overvoltage at the receiving substation, De Sieno continued. Four 40-Mva shunt reactors, two at each end, will control these voltages.

Stability Aided by Low Reactance

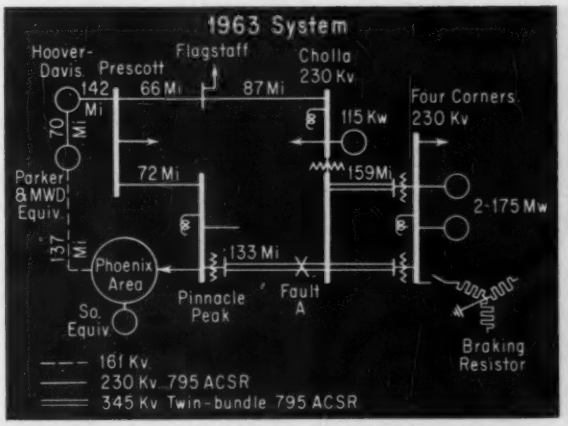
Transient stability during a 3-phase fault sets stringent switching-time limits, they added. But cutting the main-transformer-bank impedance to 8% and boosting exciter response to two per unit gives enough margin over the 4.5-cycle maximum clearing time of 25,000-Mva 3-cycle breakers.

Startup of auxiliaries at Breed Plant also posed critical problems, said V. P. Rader, AEP Service Corp, in a paper co-authored by S. G. Vassiliev. It involves starting motors up to 13,500 hp via a 186-mile 345-kv link, as there is no adequate local supply. This, said the authors, places the inductances of motors and transformers in parallel with line charging capacitance high enough to build up excessive voltages when a line breaker is opened. Resultant electrical losses could impose severe braking torques on the motors. Furthermore, they observed, motor slowdown could drop the frequency enough to aggravate resonant overvoltages and torques.

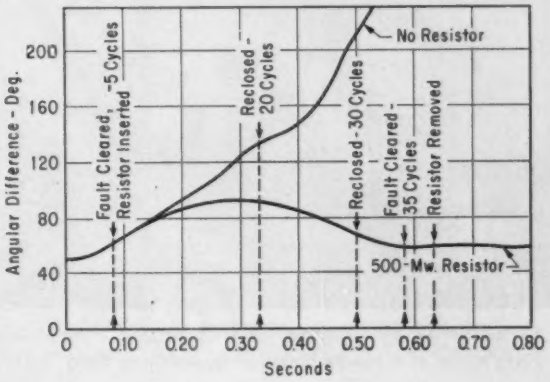
Analog and network analyzer studies of possible combinations of supply lines and auxiliary equipment revealed voltages exceeding 180%, currents up to nine times normal, and torques up to 10.5 times motor rating, they said. But the same analyses showed that predetermined switching during generation-down periods could reduce these excesses to tolerable levels. After confirmation by field tests at Breed Plant, this has become operating practice, they said.

Fault calculations can be completed in minutes by use of three new digital-computer programs described by A. H. El-Abiad, Ruth Guidone, and G. W. Stagg, all of AEP Service Corp. One is designed for 3-phase faults on a system up to 235 buses and 470 circuit elements. The second computes zero-sequence currents and includes up to 1,000 mutuals. The third combines the two and prints out 3-phase and line-to-ground-fault currents, they said, with errors eliminated and at about 20% the cost of previous methods.

(*More AIEE Summer Meeting on page* 84)



BRAKING RESISTORS at Four Corners bus (above) buy time for fault clearing, fast reclosing without pullout (below)



115-Kv Overhead

D. R. WILLIAMSON, Design Engineer, Georgia Power Co, Atlanta, Ga.

A 115-kv overhead transmission line along Atlanta streets and crossing over the North Expressway was Georgia Power Co's solution to the problem of bringing 200 Mw from a plant west of the city to the major transmission substations within the city's limits.

The 1.6-mile line was designed to permit transferring existing circuits—two 19-kv feeders, a 4-kv feeder, secondary distribution, and a 600-v dc feeder, as well as a telephone cable. Overhead construction was selected after underground designs had been studied.

Building a high-voltage line along congested city streets compelled Georgia Power to design the line to meet these requirements:

1. Graceful appearance for good public relations.

2. Durable materials to reduce maintenance and service interruptions.

3. High-strength steel to make the structures sized for the available space as safe as possible.

4. Placement of 115-kv conductors over the streets so as not to encroach on private property and to facilitate construction.

5. Use of an anchor-bolt foundation to speed construction, facilitate replacement, and minimize interference with traffic.

6. Consolidation of circuits on one support.

Limited space between curb and sidewalk dictated a 24-in. maximum tower dimension at the ground line. This, along with the heavy-loading requirements of the numerous circuits, were factors in the selection of high-strength steel for the structures.

Tower loadings were calculated to limit spans to 450 ft for the 115-kv circuit, and 225 ft for distribution and telephone circuits. Attachments provided for in the design were:

1. One $\frac{5}{16}$-in., seven-strand steel ground wire having a maximum tension of 2,400 lb.

2. Three 115-kv, 1,033.5-MCM, 37-strand aluminum phase conductors having a maximum tension of 4,500 lb.

3. Three 636-MCM ACSR 19-kv primary conductors having a maximum tension of 2,000 lb.

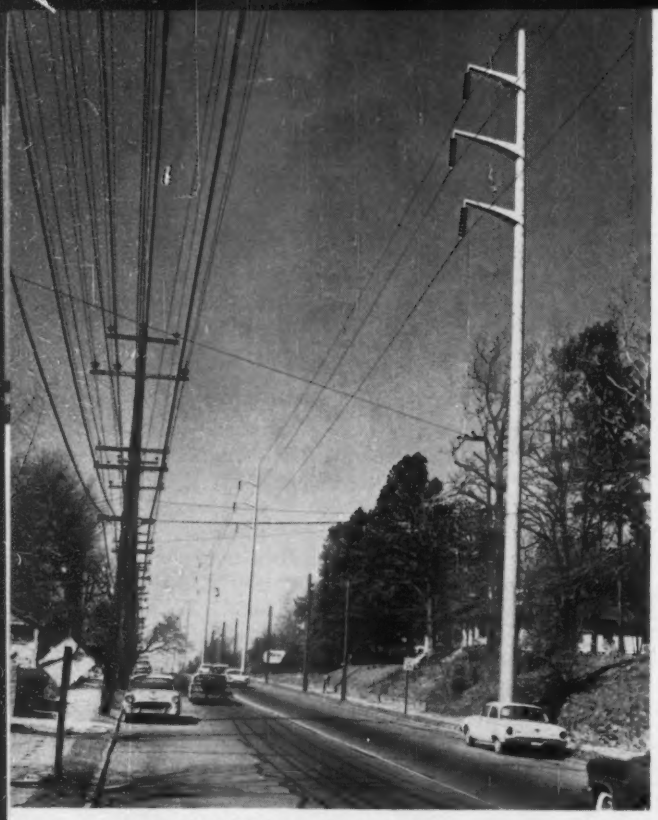
4. A 110/220-v secondary distribution circuit of four No. 4/0 ACSR conductors having maximum tension of 1,500 lb.

5. One 2-in. telephone cable having a maximum tension of 2,800 lb.

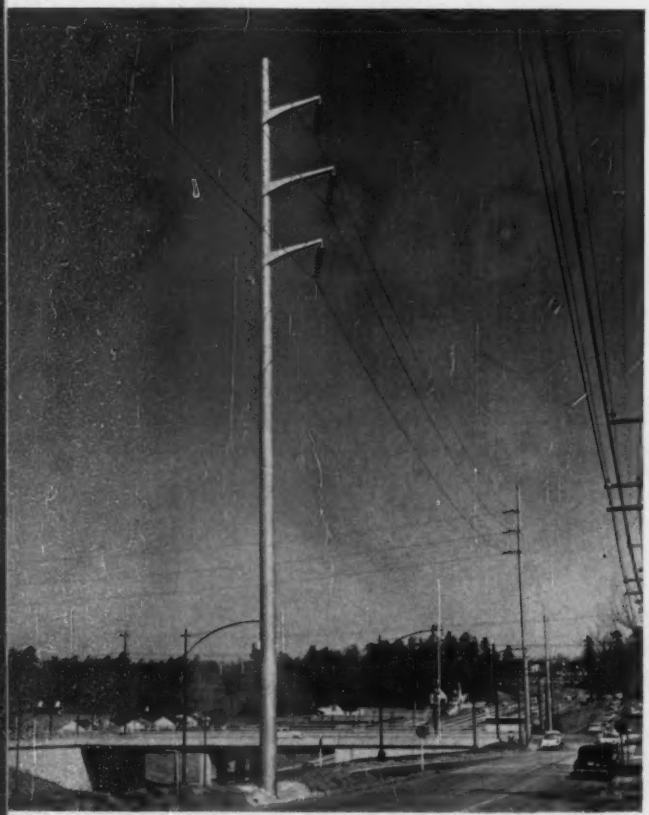
6. One street light luminaire attachment.

Although Atlanta is in the National Electric Safety Code medium-loading area, where design requirements are for ¼-in. radial ice and 4 psf (40 mph) wind, actual transverse loading of a 15-kv line is 9 psf (60 mph) wind loading, no ice. The probability of a 60-mile wind is sufficient to warrant the design of a line on that basis. But 60-mile winds do not occur under icing conditions. The Safety Code requirement for the ¼-in. ice and 4-lb wind design is for safety factors of 1.27 for the vertical loads and 2.54 for the transverse loads.

With these parameters in mind the tangent, self-



STEEL STRUCTURES for congested city streets met requirements for appearance, durability, and available space



EXPRESSWAY set obstacle for underground transmission. Poles came in three sections for assembly in field

Line Brings 200 Mw Along City Streets

supported tower stresses were calculated for a 2-deg line angle and three assumed conditions:

Condition 1. All wires intact; ¼ in. radial ice and 4 psf (40 mph) wind. Vertical loading safety factor 1.27; transverse loading safety factor 2.54, the standard factor for Grade B medium-loading conditions.

Condition 2. All wires intact; no ice and 9 psf (60 mph) wind. Vertical loading safety factor 1.27; transverse loading safety factor 2, special for medium loading.

Condition 3. Two broken 115-kv conductors; ¼-in. radial ice and 4 psf (40 mph) wind. Conductor tension relaxation of ⅔ and a longitudinal factor of safety of 1.1 were assumed.

Fiber stresses under Condition 2 are 6% below the manufacturer's calculated yield strength of the structure. Under Condition 2, stresses exceed those of Condition 1 by 22%, which shows the effect of the no ice-60-mph wind design and safety factor of 2. This controlled the pole section modulus. Wind loads contribute virtually all the combined stress.

Condition 3 determined arm size. Assuming support from the ground wire and lower conductors, pole stress is less than under Condition 1.

The tangent tower design exceeds the Grade B NESC medium-loading requirements.

Poles are high-strength structural steel, circular in section. They were delivered in three separate sections:

1. Bottom section, 0 gage steel ($\frac{5}{16}$-in.), 28 ft long with anchor-bolt base and 24-in. ground line dia.

2. Middle section, 3 gage steel (¼-in.), 30 ft long.

3. Top section, seven-gage steel ($\frac{3}{16}$-in.), 37 ft long and with a top diameter of 12⅜-in.

Minimum yield strength of the steel, 48,000 psi, allows a bending moment at the base of 530,000 ft-lb without appreciable permanent set in the pole. The 48,000-psi minimum yield strength was verified by previous full-scale tests on 230-kv guyed structures.

Poles were supplied in 80, 85 and 90-ft heights, the different heights obtained by decreasing the length of the top section of the 90-ft pole. A cast aluminum oval cover at the top of the pole provides ventilation but keeps water from entering the pole. The 90-ft pole weighs 6,000 lb, complete with arms.

There are 18 structures on the line, 12 angle structures. The line is insulated with eight standard disc insulators per string, giving a BIL of 760 kv. Phase spacing is 8 ft. The shielding angle is 30 deg. Estimated outage rate is 1.3 per 100 miles per year. Grounding was provided by rods driven to give a maximum resistance of 15 ohms. Initial aluminum conductor clearances provide for creep resulting from maximum tension held for 24 hr and normal 60F initial loads held for 20 years.

With the exception of 115-kv circuit arms and guys, pole attachments are banded. When distribution circuits are transferred, the attachments to the steel poles will be banded.

The 115-kv crossarms were designed for broken-conductor conditions. They are of the built-up beam type, fabricated from seven-gage ($\frac{3}{16}$-in.) steel. The curvature of the arm presents a pleasing appearance and its size gives a balance of architecture.

Arms were installed with a double through-bolt arrangement which increased the strength longitudinally, as compared to a single-bolt bracket arm. Arms are of two different lengths, 6 ft 9 in., and 8 ft 6 in. The shorter arms are in the center, the longer ones are top and bottom. This arrangement provides conductor offsets to prevent trouble under sleet jump conditions. Arm attachments are standard, all arms fitting the three positions on the poles, left or right.

Foundations were designed to be rectangular, rather than round, because:

1. Auger excavation involved greater possibility of damage to laterals from water and gas lines.

2. Hand excavation obstructs traffic less.

3. The rectangular foundation accommodated anchor bolts with a minimum dimension at right angles to the sidewalk and street, curb and street not being disturbed.

4. Anchor bolts with a double system of nuts was a convenient method of plumbing the structure and minimized the time that equipment obstructed traffic.

5. If struck by traffic, a structure can be replaced in a minimum time.

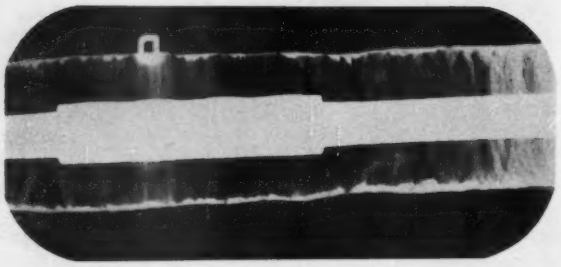
The concrete foundations are 4 by 5 by 11½ ft deep. It was necessary to place 2 ft of the pole in the ground as the anchor base plate and section braces exceeded the 24-in. between curb and sidewalk. Foundation anchor bolts are 2 in. dia, 96 in. long.

BASE PLATE and braces overspread space between sidewalk and curb and has to be set 2 ft into the ground

X-Rays Show

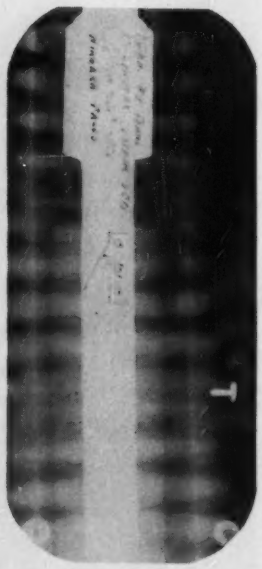
Good workmanship or incipient weaknesses

T. L. **BOURBONNAIS II**, Engineering Service Div, E. I. du Pont de Nemours & Co, Wilmington, Del.



EXCELLENT WORKMANSHIP shows in radiographs of cable splice and pothead (below). Splice x-ray shows uniformity of solder up and down sides to hold shielding tape in place

VOID IN 15-KV POTHEAD (dark area, upper left) extends from top of porcelain to pouring plug in brass base



VOID EVIDENT in 33-kv pothead is thought not detrimental. Original insulation of the cable can be distinguished

Non-destructive inspection of power cable terminations and splices using x-ray analysis has been developed by the engineering department of E. I. du Pont de Nemours & Co. This method can detect incipient weaknesses of material or workmanship in cable connections through use of standard industrial x-ray equipment and techniques. To date the method has uncovered major or minor defects in 95% of termination inspected in about 80 plants of the Du Pont company.

The author believes the utility industry will find this new method of great interest for two reasons:

1. X-ray analysis uncovers serious as well as minor defects which might pass undetected by high-voltage tests. Over 250 radiographs have revealed such defects as use of improper materials, incorrect assembly of potheads, improper tightening of mechanical connections, the absence of stress cones on shielded cable in potheads, improper application of shielding tape on stress cones, and presence of voids in places where they could result in ultimate failure of the connection. The inspection can be made immediately upon completion of the termination.

2. Power cable terminations in Du Pont plants from coast to coast are made by company splicers, by cable splicers of the serving utility, and by many transient construction mechanics. It is believed the company's experience is representative of termination and splicing work throughout the country. Thus the same splicers working in its plants could very well be making splices on electric utility properties.

A corollary but equally important reason is that cable splicers have reacted to the results of x-ray analysis by improving their work methods and thus making better terminations. No small part in the improvement in terminations has resulted just from the psychological effect of the presence of x-ray equipment at the job site. Considerable time and effort has been given to showing the radiographs (x-ray pictures) to the splicers who have done the work. One hard-to-convince cable splicer at a company plant, after inspecting some radiographs, said, "If I hadn't seen it, I wouldn't have believed it," referring to voids in the compound he had poured into a pothead. However, the latest pothead he poured was excellent.

Satisfactory terminations and defects uncovered in other connections are shown in the accompanying illustrations. These radiographs were taken with equipment made with a portable x-ray machine. An iridium isotope camera also has been used with excellent results. This camera requires a little more skill in its use

Condition of Terminations

in materials or methods can be found with non-destructive inspection and analysis

because its continually changing intensity of radiation requires a difference in exposure time from day to day.

A major consideration in the use of x-ray equipment is the potential hazard to personnel from radiation. However, this hazard can be guarded against rather easily. A radiation meter is used during x-raying of terminations at Du Pont plants to indicate the limits of danger to personnel in the vicinity of the work. The radiographer, at the very least, should wear a film badge or dosimeter to record the amount of radiation received. The dosimeter can be read easily during the working period to check the amount of total absorbed radiation at any time. This instrument requires a special power supply for its setting.

Check With Radiation Meter

The radiographer and others can take advantage of masonry walls which are effective shields against radiation, but checks with the radiation meter should also be made. With the equipment used by Du Pont, a 50-ft cable between the x-ray generator and the control box provides a safe distance from the radiation source during its operation. The radiation meter, however, indicates that this distance normally is not required.

X-ray analysis of cable terminations can be provided through the services of a local industrial x-ray firm. It has been found that technicians from these firms quickly adapt themselves to performing x-ray inspections of most any object once they understand what they are expected to find. It is also feasible for a utility to purchase x-ray equipment and train someone for the job.

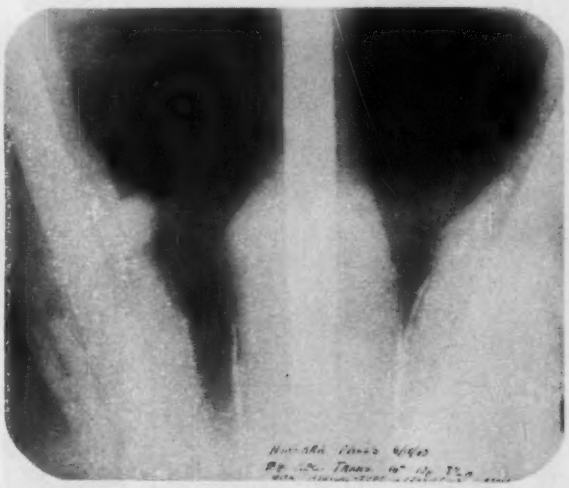
Choose Dark Room Techniques

All of the radiographs taken by Du Pont of field installations were developed in the particular plant's medical dark room. The same technique of developing was used as is normally used for medical x-rays. This simplifies the process in that the x-ray film holders can be given to the regular medical dark room technician for processing and refilling. Better radiographs can be obtained by using special laboratory techniques tailored to this particular type of industrial x-raying. But from the standpoint of economy, most developing can be handled in a company's medical dark room.

One precaution about using company facilities for processing of x-ray films should be observed. Dark room handling of film, including the processing, is most often the source of all problems in producing good radiographs. While even good processing cannot correct for errors introduced during the exposure of the film, improper dark room procedures and failure to maintain processing solutions properly in most cases will impair the quality of properly exposed film.

Several types of industrial x-ray films are available. A general purpose type, for use with or without lead screens in the film holder, provides a good balance between radiographic sensitivity (film speed) and detail of the object x-rayed. If a sharper, more detailed record is desired, a very fine grain film should be used. This film, however, requires about three times the exposure of the general purpose film. Also available is a film to be used with intensifying screens of the fluorescing type in the film holder.

TWO VIEWS OF SAME POTHEAD show absence of stress cone inside the base. Void (dark area adjacent to plug, left view) is probably serious, for water might enter through breathing. Right view is taken looking directly at the pouring plug in the pothead's base



STRESS CONE DISTORTION appears in radiograph taken through cast-iron base of pothead. Voids (dark areas, left) existed about 24 hr after pour. Voids may heal with time, but distortion of stress cones is a disturbing factor

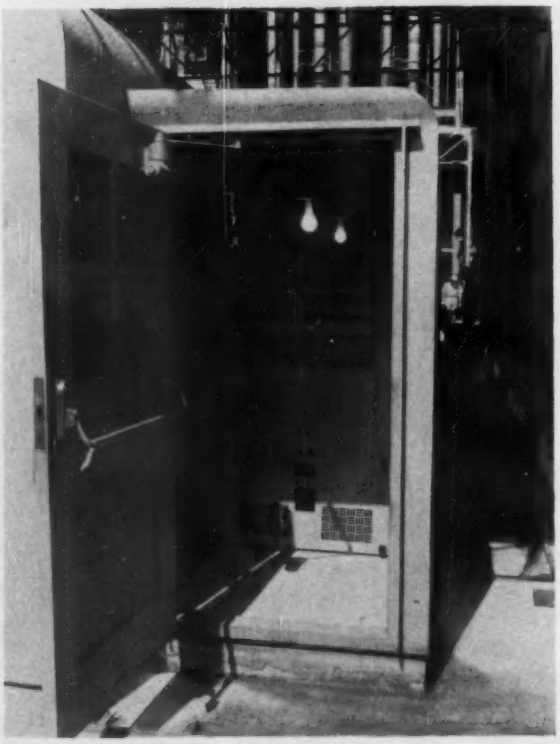
Integrate Field Breaker and Generator

W. C. STIVERS, Supervising Engineer, Bechtel Corp, San Francisco, Calif.

A new design of exciter housing that lets the generator field circuit breaker be installed as part of the turbine generator has resulted in lower installed costs and considerable space saving at the new outdoor Port Everglades Plant of Florida Power & Light Co. The exciter housing that accommodates the breaker was furnished by Westinghouse Electric Corp for two 200-Mw turbine-generators installed by Bechtel Corp.

Large turbine-generators now being built, and particularly those generators using conductor cooling, require greater excitation power. Generally, exciter voltages have been limited to 375 v, and excitation currents have exceeded 3,000 amp. These currents require large conductors between the exciter, field circuit breaker, and generator field slip rings. These conductors must compete for space underneath the generator with the main generator bus, usually metal enclosed and rated 6,000-10,000 amp, and in some outdoor installations with exciter cooling air ducts.

In some installations the space restrictions have resulted in recommendations to eliminate the field breaker altogether, and to bus the exciter directly to the field slip rings, as has been done on some hydrogenerators. With rotating exciters, however, the possibility of minimizing machine damage in case of field or stator fault by faster field decay provided by tripping a field breaker makes its elimination undesirable.



FIELD CIRCUIT BREAKER mounted in exciter housing of outdoor turbine generator cuts installation time, saves space

Westinghouse was requested to study the possibility of locating the field breaker within the walk-in exciter enclosure. An acceptable alternate, though a less desirable location, was a separate outdoor enclosure alongside the exciter housing. The final design was a combination—an enclosure alongside of, but also a part of, the exciter housing. The mounting of the circuit breaker on the isolated foundation for the turbine-generator exciter rather than on the building floor prompted the manufacturer to recommend use of a fixed breaker rather than a drawout breaker because of possible connector wear. Suitable access has been provided for maintenance and inspection. In addition to the field breaker, the enclosure contains the field discharge resistor and the field ammeter and temperature recorder shunts.

Westinghouse provided a bus connecting the exciter and the slip rings to the field breaker. The bus is placed in a trench in the top of the generator pedestal. This installation resulted in a savings of approximately $3,000 per unit in labor and material compared to installation of an outdoor breaker beneath the generator. The advantage of releasing space usually occupied by conductors and field breaker cubicle is hard to evaluate in dollars but is gratifying to the design engineer and helpful to future maintenance personnel. The reduced congestion beneath the generator might very well provide additional savings in simplifying the generator bus run in certain installations.

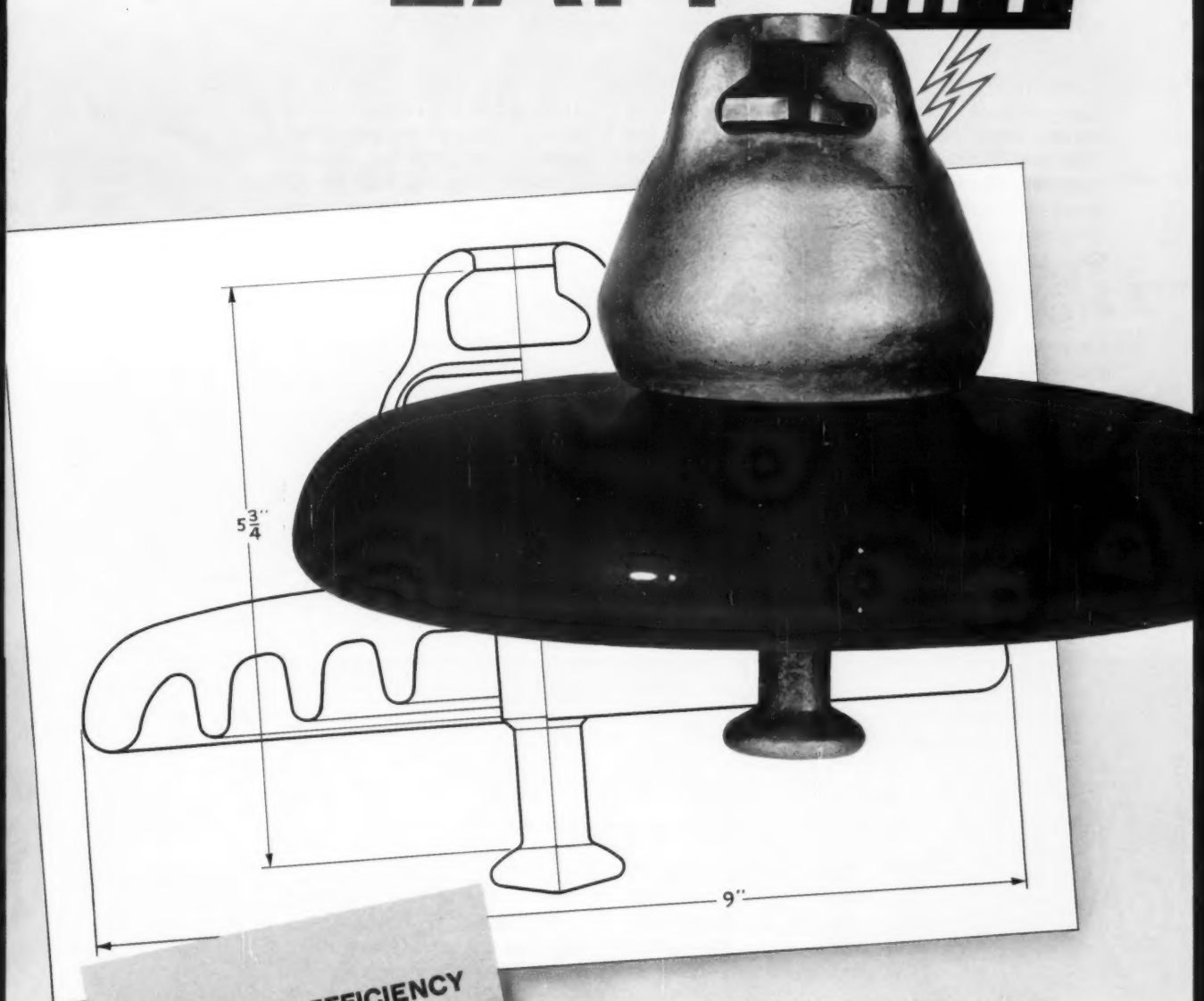
On the Port Everglades machines a closed cooling system is required for the exciters; the elimination of field current conductors beneath the machine made it possible to place all the air ducts and the heat exchanger between the generator bus and the underside of the generator pedestal, thereby providing additional savings in duct work.

Past practice has been to combine the field breaker cubicle with other cubicles containing the voltage regulator and motor-operated exciter field rheostat. Additional savings were made in the Port Everglades installation by having the regulator and rheostat built into indoor enclosures and installed beneath the control room. Only the leads to the exciter fields are brought out to the exciter. All control leads are short, running directly from the control board to the regulator cubicle.

The design for this field breaker resulted in an installation that is both attractive and economical. It provides outdoor protection for the field breaker and accessories and is built to provide easy access for inspection and maintenance.

NEW FROM LAPP

Hi-F



HIGH-EFFICIENCY "COMPACT MODEL" SUSPENSION INSULATOR

FUNCTIONAL DESIGN FOR "NORMAL" TRANSMISSION DUTY ...AND INTERCHANGEABLE WITH NEMA STANDARD INSULATORS

WHY ANOTHER SUSPENSION INSULATOR?

Specifications for transmission line insulators almost unanimously call for "Standard 10-inch disc, 15,000-lb. suspension units." Physical dimensions of this insulator have not changed significantly in 40 years. But manufacturing techniques and qualities of materials have. Thanks to compression glaze, compression sand bands, ever-better porcelain body, improved manufacturing controls and minor cap-head-and-pin design improvements, Lapp's standard 15,000-lb. suspension disc routinely tests today to an M & E strength of just about 25,000 lbs. Yet, a great majority (probably more than 75%) of transmission lines in service today—and of those now being constructed—impose working loads on insulators of only a few hundred to perhaps 4,000-5,000 pounds.

For use on lines so lightly-loaded, it seems economically unwise for you to be required to specify —and pay for—an insulator with strength characteristics you don't need—and can't use!

WHAT IS THIS NEW INSULATOR?

Lapp calls it "Hi-F" (for "high-efficiency" of course). Its 9″ diameter disc is 1″ smaller than the "standard" unit. Its head also is 1″ smaller in diameter. Electrical characteristics—leakage distance—string flashover, wet, dry and impulse—are therefore the same as current NEMA standards for the 15,000-lb. insulator. Hi-F is rated 14,000 lbs. combined M & E strength, and is recommended for service with an adequate safety factor at working loads up to 7,000 lbs. Impact strength rating is 55 in-lbs., identical with the NEMA standard 10″ unit. Hi-F uses the same ball-socket details, so is physically interchangeable with NEMA standard 15,000 and 25,000-lb. suspension insulators.

HOW IS ITS RELIABILITY ASSURED?

Lapp has always maintained that stresses and strains in a suspension insulator over its lifetime of service are complex and subtle factors. So subtle indeed that any significant change from time-tested design carries with it a hazard to reliability.

That's why Hi-F is a new design that's made up only of time-proved "components." The cap-head-and-pin design is that of the Lapp No. 6605 6″ dead-end insulator, which is time-proved by more than 30 years of successful and distinguished service (and which, with an M & E rating of 10,000 lbs., has routinely been testing at 16,000 to 19,000 lbs.). *Because the cap of Lapp Hi-F is 1″ smaller in diameter than that of the 15,000-lb. standard unit, identical electrical characteristics are provided by a shell that also is 1″ smaller in diameter.*

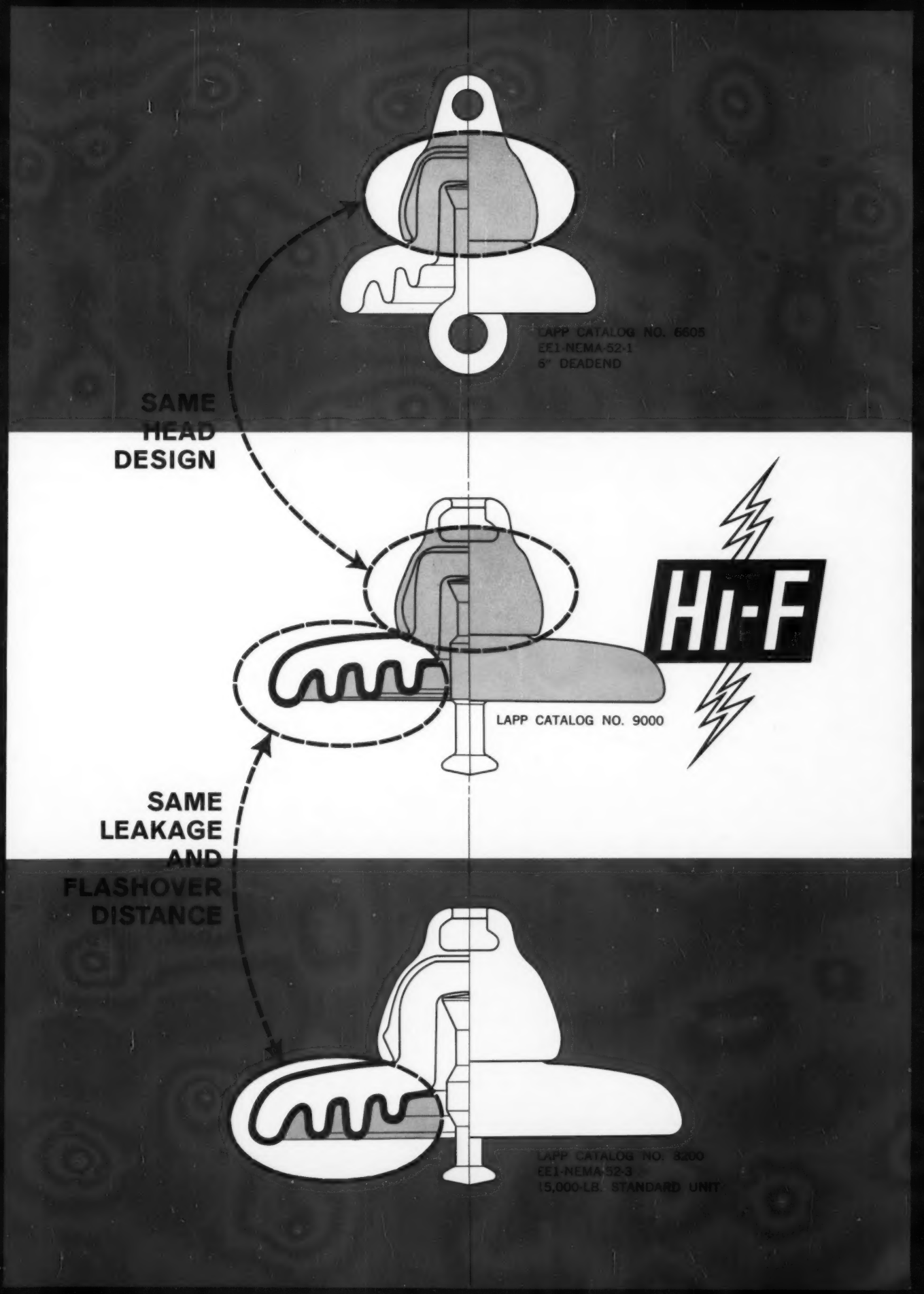
Design of Lapp Hi-F, then, is a *combination* rather than an *innovation*. All components are of time-proved design; Lapp's progress in manufacturing techniques, control and material quality, permit their combination in the first "functional design" suspension insulator in more than a generation.

HOW ECONOMICAL?

Designed for "normal duty" transmission lines—and not extravagantly over-designed—Lapp Hi-F carries a substantially lower price than the conventional 10″ insulator. Weighing about one-third less, it costs less to handle in the field, offers a smaller target for stones and bullets, and may be worked more easily with hot-line tools. Fairly priced at $2.50 (in 24,000 lb. lots), Lapp Hi-F offers economy to the user, at a price that affords fair profit to the manufacturer. Sample units are now available.

WHERE CAN HI-F BE USED?

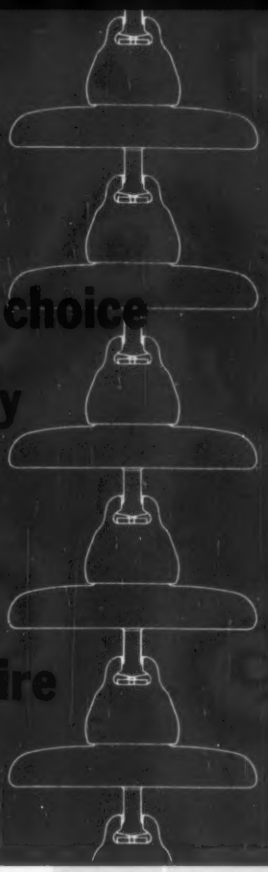
Lapp Hi-F provides an adequate safety factor for any suspension use up to a working load of 7,000 lbs. It is ideally suited to all substation and sub-transmission dead-ending. It is within the loading range of practically all wood-pole construction, as well as that of light or medium-weight steel tower lines—at any voltage. Even at the upper end of the strength scale, Hi-F will often be found to be adequate for use in the suspension position, with high-strength 10″ discs used for dead-ends.

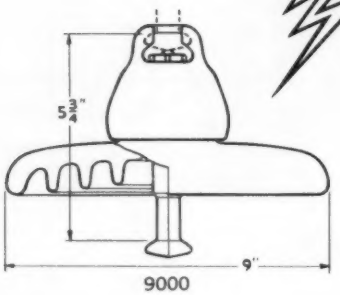

LAPP CATALOG NO. 6605
EEI-NEMA-52-1
6" DEADEND
SAME
HEAD
DESIGN
Hi-F
LAPP CATALOG NO. 9000
SAME
LEAKAGE
AND
FLASHOVER
DISTANCE
LAPP CATALOG NO. 8200
EEI-NEMA-52-3
15,000-LB. STANDARD UNIT

ONLY FROM LAPP

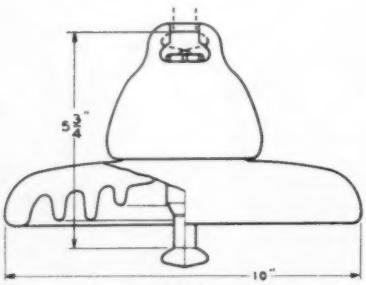
Hi-F

Another insulator choice to help you specify what you need and pay only for what you require

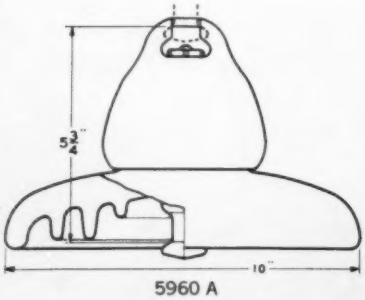




9000



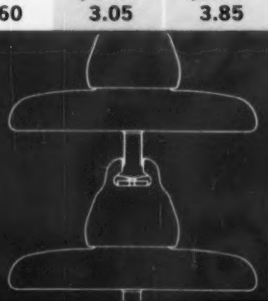
8200



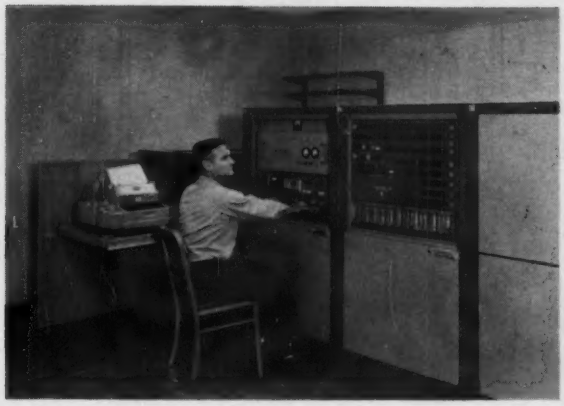
5960 A

Catalog Number	Hi-F 9000	8200	5960A
EEI-NEMA Class		52-3	52-5
DIMENSIONS			
Leakage Distance, Inches	11.5	11.5	11
Dry Arcing Distance, Inches	7.75	7.75	7.75
MECHANICAL VALUES			
Combined M&E Strength, Pounds	14,000	15,000	25,000
Impact Strength, Inch Pounds	55	55	60
Routine Proof Test Load, Pounds	7,000	6,000	10,000
Time Load Test Value, Pounds	10,000	10,000	15,000
ELECTRICAL VALUES			
Low Frequency Dry Flashover, kv	80	80	80
Low Frequency Wet Flashover, kv	50	50	50
Impulse Flashover—Positive, kv	125	125	125
Impulse Flashover—Negative, kv	130	130	130
Low Frequency Puncture Voltage, kv	110	110	110
RADIO INFLUENCE VOLTAGE DATA			
Test Voltage—Rms to Ground, kv	10	10	10
Maximum RIV—Microvolts at 1000 kc	50	50	50
PACKING AND SHIPPING DATA			
Net Weight, Each, Pounds	7.4	11	13.5
Packed Weight, Each, Pounds	7.75	12	15
Standard Package	6	6	6
PRICE			
24,000 lb. Shipments	**$2.50**	**$2.92**	**$3.70**
Less 24,000 lb.	**2.60**	**3.05**	**3.85**

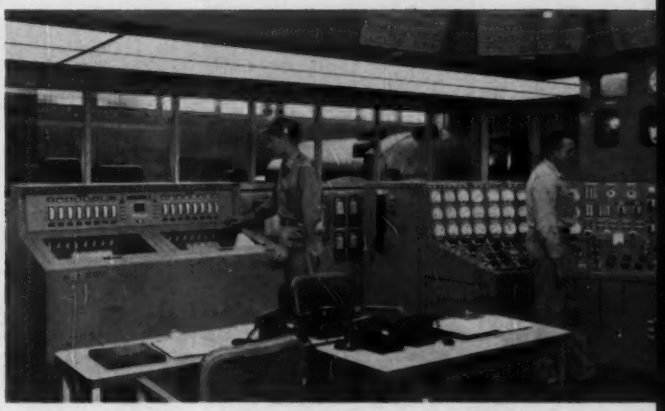
Lapp



News of Manufacturers



SYSTEM SUPERVISORY PANEL in Bergen Station is checked by technician. Programming typewriter is at his left



COMPUTER OPERATING GUIDES are observed by chief engineer (left) as operater monitors control panel

Bergen Station Gets EDP Computer

A Leeds & Northrup/Philco performance computer was placed in service this week at Public Service Electric & Gas Co's Bergen Generating Station, located at Ridgefield, N. J. The computer, one of the first of its type, is used to monitor the performance and efficiency of two 290-Mw generating units.

The fully transistorized digital computer, purchased from the Leeds & Northrup Co, was developed by them under a joint agreement with the Philco Corp. Over two years were required for the design, manufacture, programming and installation of the computer system.

One hundred and ninety-six measuring devices located throughout the plant continuously feed information to the computer. These data involve amounts of coal being burned, electricity being generated and a myriad of temperatures, pressures and fluid flows that occur during the energy conversion occuring during changes from coal to steam to electricity.

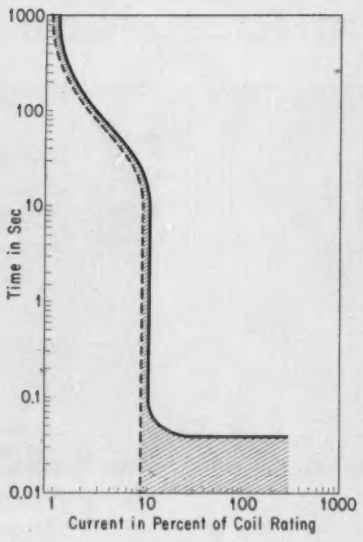
The Bergen computer system processes these data for immediate use by the station engineers to up plant operating efficiency, and for continuous monitoring of plant performance. First, as an on-line general purpose digital machine, it calculates and visually displays on panel indicators 16 operating guides which enable the station operating engineers to achieve greater plant efficiency. Second, it prints out comprehensive performance calculations and reports which will permit the plant engineers to follow boiler and turbine performance in detail. These reports cover all phases of operating results and are printed hourly, daily, weekly, and monthly. In addition, by pushing a button an operator may obtain a typed report of 50 individual operating values.

The production of operating records is a basic function of the computer, but the primary purpose of the equipment is to promote efficient operating. With the multi-million-dollar fuel cost associated with such large generating units, a small percentage improvement in efficiency will be significant in terms of annual fuel-dollar savings.

FP Introduces New LV Power Circuit Breakers

Last week, Federal Pacific Electric Co announced a new line of low-voltage power circuit breakers. The major significance of the new FP breaker series is the uprating of the individual breaker sizes. Previous standard sizes for such low-voltage units were 225, 600, 1,600, 3,000, and 4,000 amp. With the new line, the ratings for the first three sizes have been raised to 400, 800, and 2,000 amp. According to Federal Pacific's President T. M. Cole, this permits use of a smaller unit in the initial installation, yet provides greater capacity for load growth. Furthermore, by raising interrupting capacities of the three smaller breakers to 50,000-amp asymmetrical and the larger breakers to 100,000 amp, the new units provide protection more suited to the higher levels of fault currents that can occur in the larger power equipment used in modern distribution systems.

The new line is divided into FP-50 and FP-100 groups. The FP-50 series consists of three increased frame-size breakers based on continuous current ratings of 400, 800, and 2,000 amp, with 50,000 amp asymmetrical I.C. at 600 vac. The FP-100 series covers two frame sizes with 100,000-amp asymmetrical I.C. in continuous current ratings of 3,000, and 4,000 amp at



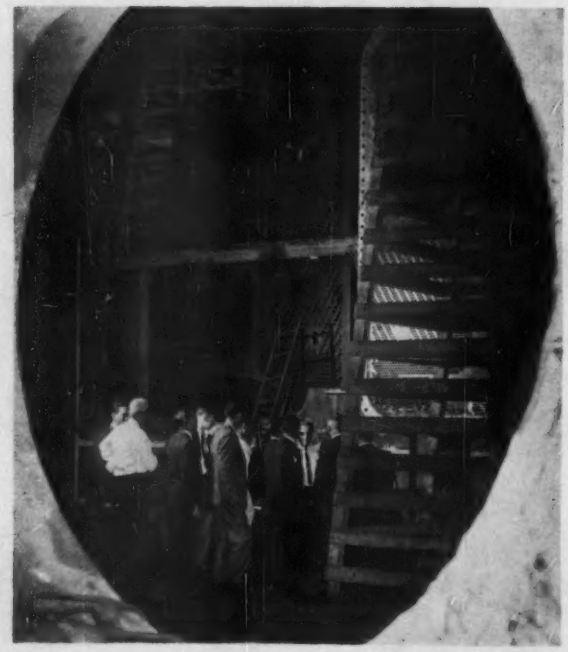
TD TIMING DEVICE (plastic encased) is screwdriver adjustable to meet future system requirements. Time-current curve above is typical of new breaker line

600 v. A simplified, fast-acting stored-energy mechanism insures a constant quick-make of breaker contacts so that contact life is extended—electrical charging of the stored-energy mechanism by means of a fractional horsepower motor is said to reduce control power requirements. Breakers may be furnished with electrical and/or manual charging systems.

The new line features a full blow-on multi-point contact structure. Each pole has multiple main contacts with individual spring loading. Configuration of moving and stationary contacts is designed so as to increase contact pressure under heavy load conditions for both main and arcing contacts. Multiple copper tungsten arcing contacts divide arc energy. Braided connections are eliminated by a self-aligning current-carrying hinge, which is said to prevent pitting under even the most severe fault conditions.

The breaker's series trip coil and magnet assembly and the TD timing device are designed to permit easy field adjustment to meet future changes in system requirements. The TD timing device is front-mounted to allow changes in trip setting with the breaker in connected position. The full range of the FP Line employs only nine different series trip coils in place of the 28 required by conventional breakers. This has been achieved by development of a variable magnetic structure (screwdriver adjustable) which in effect gives each coil size two-to-four different ratings. Thus, the need for coil replacement is reduced by 66%. In the infrequent case where coils must be changed, replacement can be handled easily on location by maintenance personnel. Federal Pacific reports that by doing this shut-downs while awaiting coil replacement by the manufacturer are generally eliminated.

Worthington Holds Power 'Pow-Wow'



Technical representatives of Worthington Corp's Harrison Div recently met at Harrison, N. J., for a three-day updating on Worthington's electric utility products and the latest equipment trends in the utility industry.

The activities included product sessions and shop demonstrations. Product orientation sessions were run concurrently, classroom style, with question-and-answer periods. Shop demonstrations, before and after classroom discussions, showed the latest techniques in the manufacture of Worthington equipment for the utility industry.

Associated equipment, other than Worthington's, which is included in the utilities' power generating cycle, was integrated into the discussions and shop demonstrations. It is reported that the success of the indoctrinating sessions was such that plans are being made to set up the "pow-wow" on a yearly basis.

◀ **TECHNICAL REPRESENTATIVES** are briefed on the latest features of 105,000-sq-ft service condenser being shop-fitted and assembled for a utility's steam-generating plant

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When you select from General Electric's full line of oil cutouts, you are assured of positive load break, high current-interrupting capacity, and a full range of cable terminations for fast, easy installation.

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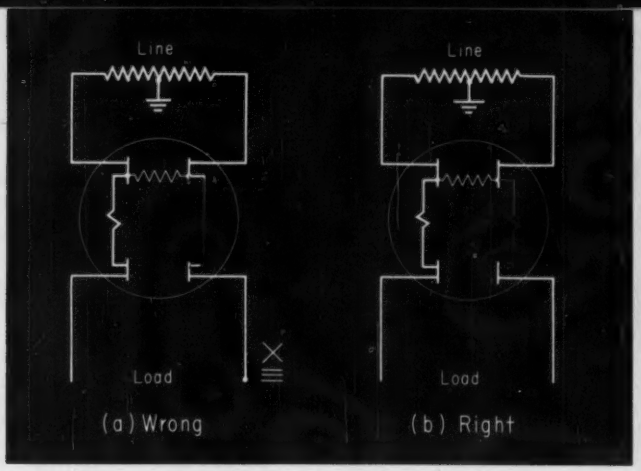

FIG 1—SINGLE-PHASE, TWO-WIRE METER used incorrectly (a) will allow unmetered power to be taken from point "X" to ground. This type of installation requires a single-phase, three-wire meter connected as indicated in schematic at (b)

Wire With Care to Avoid Simple Pitfalls

DAN McAULIFF, Asst Engineering Manager, Sangamo Electric Co, Springfield, Ill.

The mis-application of metering equipment is not confined to complicated special setups but quite often occurs during routine installation of self-contained meters, including the single-phase, watthour meter. While various publications show correct and accepted metering practices and while many "errors" could be shown, this presentation examines several simple mis-applications that can catch the meter man off guard.

Two-Wire Meter Can Be By-Passed

An incorrect use of the single-phase, two-wire meter is shown in Fig 1a. Although only two wires enter the customer's service, the grounded center tap on the distribution transformer constitutes a third wire. Because ground undoubtedly is available on the load side of the meter, unmetered power can be taken from point "X" to ground. This installation requires a single-phase, three-wire meter, as shown in Fig 1b.

Watch Grounds on 3-Wire Metering

A metering mistake that is frequently encountered is illustrated in Fig 2a. Because many utilities have a limited supply of two-wire meters, they use a three-wire meter on a grounded two-wire service. If point "X" is either deliberately or accidentally grounded, a parallel current path will exist around the right-hand current coil of the meter. Even though the current coil impedance is relatively low, revenue still can be lost by this unmetered ground current. If properly connected, however, the three-wire meter can be used very easily on two-wire service, as shown in Fig 2b. The modern 240-v watthour meter has proved to have acceptable accuracy for this 120-v application.

Grounded Delta Needs 4-Wire Meter

The three-phase, three-wire meter can be mis-applied as shown in Fig 3a because a three-wire delta may have a grounded center tap to reduce voltage above ground. The existence of this ground creates a situation similar to that shown in Fig 1a, i.e., the ground constitutes a fourth wire. Even though only three wires enter the customer's service, unmetered power can be taken from point "X" to ground unless a four-wire delta meter is installed, as in Fig 3b.

Grounded Delta Poses Other Problems

The three-phase, four-wire delta meter is frequently misconnected or misused. In Fig 4a is shown an incorrect installation resulting from random connection of the three hot wires. Random connection is normal and of no consequence on other types of self-contained meters, but the four-wire delta meter must have the polyphase leg as well as the ground wire connected to the proper meter terminals, as in Fig 4b. Even when properly connected, the four-wire delta meter can be the wrong capacity if the amperes of the single-phase load are not considered. Thus, it is possible to have adequate total meter capacity but severely overloaded single-phase current coils.

Window-Type CT Has Unique Pitfall

Installations involving instrument transformers offer a much greater variety of mistakes, such as reversed

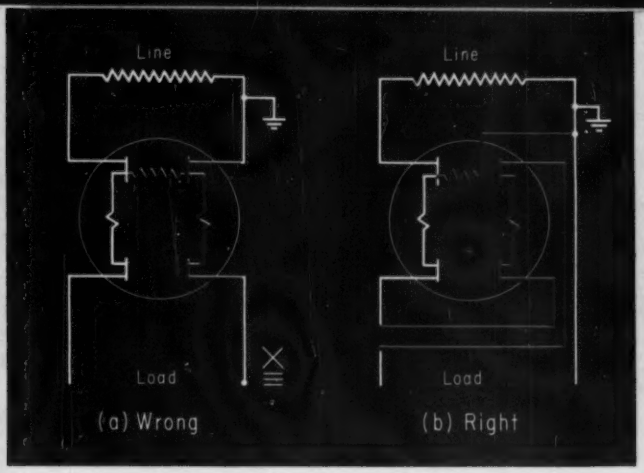

FIG 2—SINGLE-PHASE, THREE-WIRE METER on grounded two-wire service (a) will provide a parallel current path if point "X" is grounded. Proper connection of meter can be made very easily as indicated in the schematic diagram (b)

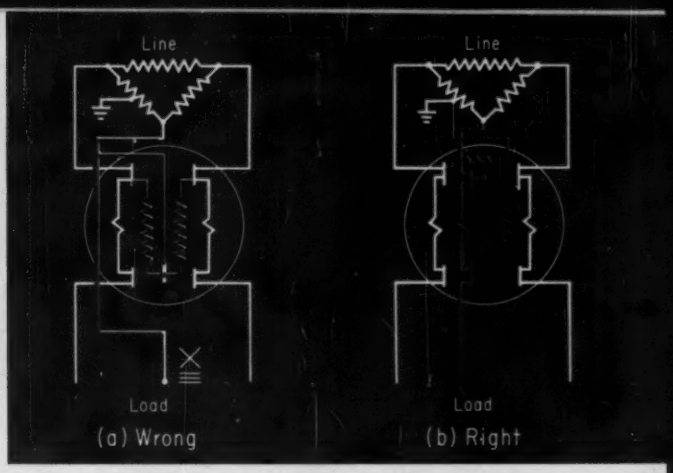

FIG 3—THREE-PHASE, THREE-WIRE METER will be misapplied (a) if the three-wire delta has a grounded center tap. Unmetered power can be taken from point "X" unless a four-wire delta meter is used as indicated in schematic (b)

in Metering

polarity and improper association of current and potential. However, space does not permit an analysis of all these possibilities. An installation found in many handbooks and worth discussing here is shown in Fig 5a. It is an economical way of measuring a four-wire, delta load with only two current transformers and a three-phase, three-wire meter and socket. This particular circuit contains a unique pitfall because of the increased popularity of the through or window-type current transformer.

As drawn, Fig 5a is correct with a 200:5 transformer in the polyphase leg and a 200/200:5, three-wire transformer in the single-phase circuit. However, a 200:5 window-type transformer in the single-phase circuit becomes a 100/100:5 transformer and cannot be used with the other 200:5 transformer. Therefore, the installation requires a 400:5 window-type transformer in the single-phase circuit; the multiplier is 40.

Metering of this circuit with identical transformers is accomplished by using two 400:5 window-type transformers with two turns in the polyphase leg, as shown in Fig 5b. However, it must be noted that a multiplier of 40 should be used, rather than the nameplate ratio of 80.

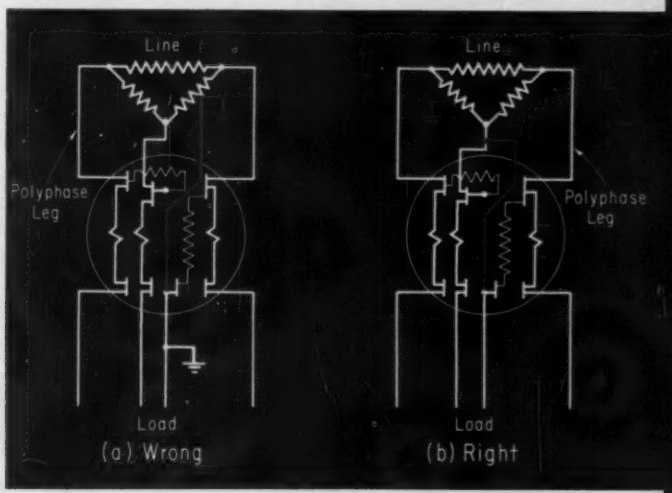

FIG 4—THREE-PHASE, FOUR-WIRE DELTA METER may be installed incorrectly (a) through random connection of three hot wires. Polyphase leg as well as grounded wire must be connected to proper terminals as indicated in schematic (b)

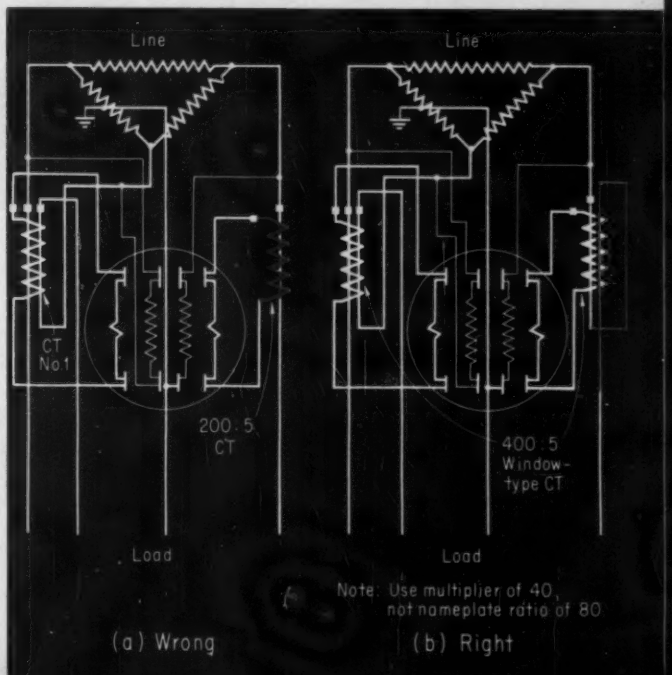

FIG 5—INSTRUMENT TRANSFORMER SETUP (a) will be incorrect if CT No. 1 is a 200:5 window-type transformer but correct if it is a 400:5 window-type or a 200/200:5, three-wire type. The correct wiring arrangement for two 400:5 window-type transformers is shown in schematic diagram (b)

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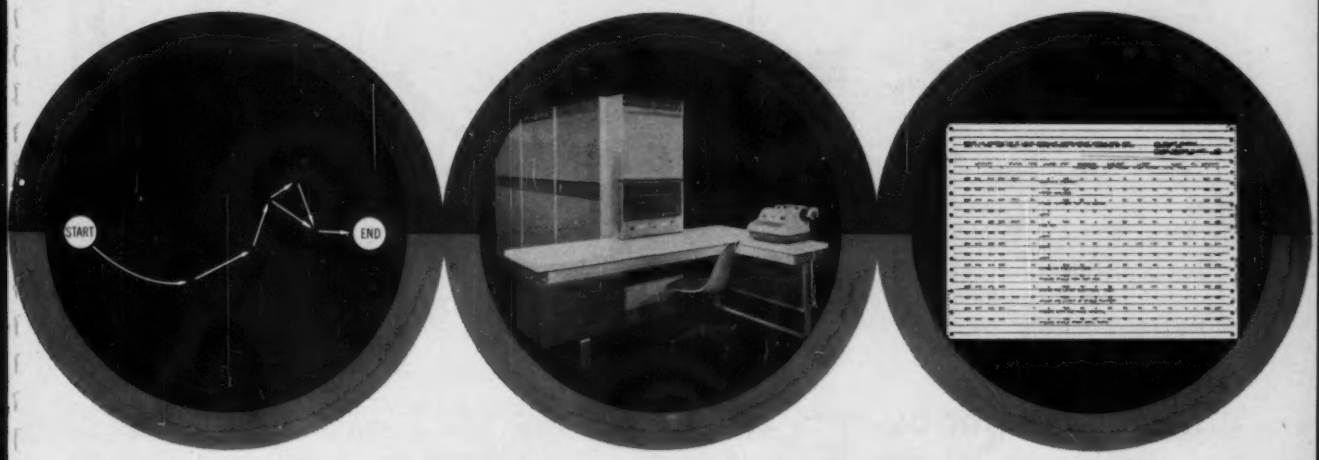

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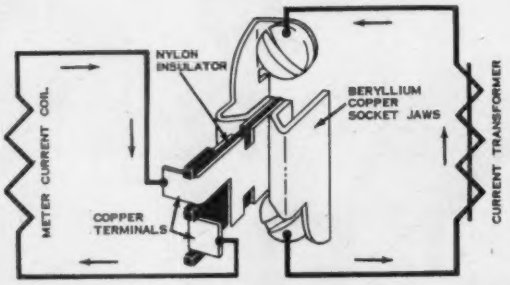
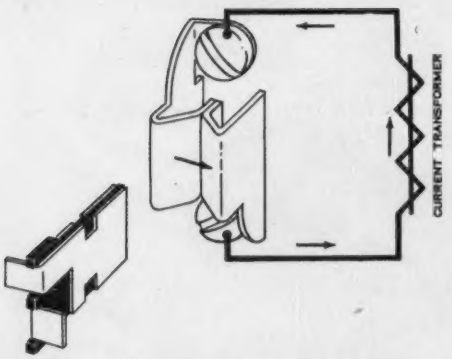
*THIS METHOD WAS DEVELOPED BY MAUCHLY ASSOCIATES, AMBLER, PENNSYLVANIA—TORONTO, CANADA.

New Equipment



METER INSERTED: Current terminal socket jaws are separated by the dual bayonet current terminals connecting the meter current coils into the transformer secondary

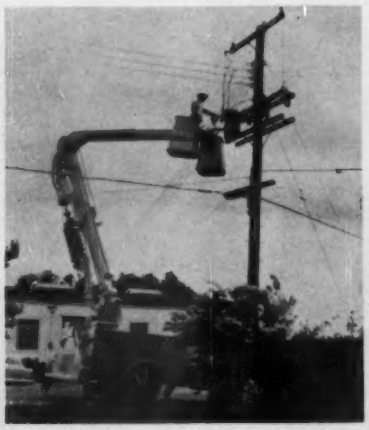


METER REMOVED: Terminal jaws, under spring tension, automatically come together, thereby insuring positive short-circuiting of the current transformer secondary

Meter Current By-pass . . .

. . . provides positive and reliable automatic current by-passing on socket-type transformer-rated meter installations. The Autopass metering equipment guards against loss of revenue, transformer and socket damage, and hazardous high voltages that result from the possible failure of conventional current by-pass devices. The special, short-circuiting terminal jaws of the UM-2 meter mount, in conjunction with the dual current terminals of P20 (two stator) and P30 (three stator) "C" base meters, accomplish the automatic by-pass action and positive circuit opening.
Sangamo Electric Co, Springfield, Ill.

All-Purpose HV Elbow . . .



ELBOW lifts man to line-working heights; borer is fitted to lower boom

SHEAVE HEAD, manually extended, converts unit to pole-working derrick

. . . permits digger and derrick to be operated behind and on either side of the truck. The elbow, which lifts workmen up to 55-ft working heights for aerial tasks, features two sets of A-frame diagonal outrigger jacks for strength and stability. Attachment near the end of the elbow's lower boom accommodates the Holan 5400 earth borer, which can bore holes as far as 13½ ft from either side. Borer's fore and aft positioning movement is accomplished by a hydraulic with a (40-in. stroke) cylinder. Rotation of the elbow mast 360 deg continuously in either direction provides the transverse positioning movement. A special 6-ft manually extended sheave head is available for the all-purpose elbow-derrick-digger unit. The elbow, used as a derrick, can winch and lift boom from 4,000 to 6,000 lb, at head heights up to 27¾ ft at 8-ft radius—with an additional 6 ft if head height extension is used. Operating range for the lower boom when used as a derrick is from horizontal to approximately 70 deg.
Holan Corp, 4100 W 150th St, Cleveland 35, Ohio

(*More New Equipment, p* 65)

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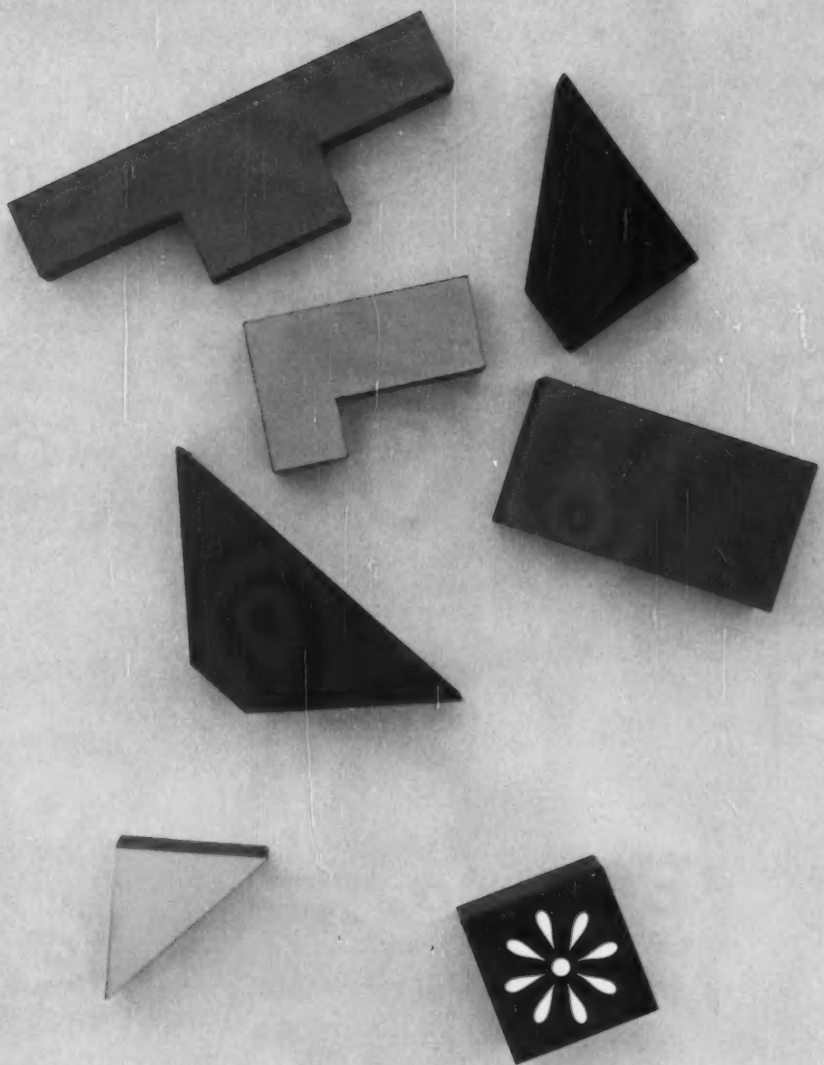

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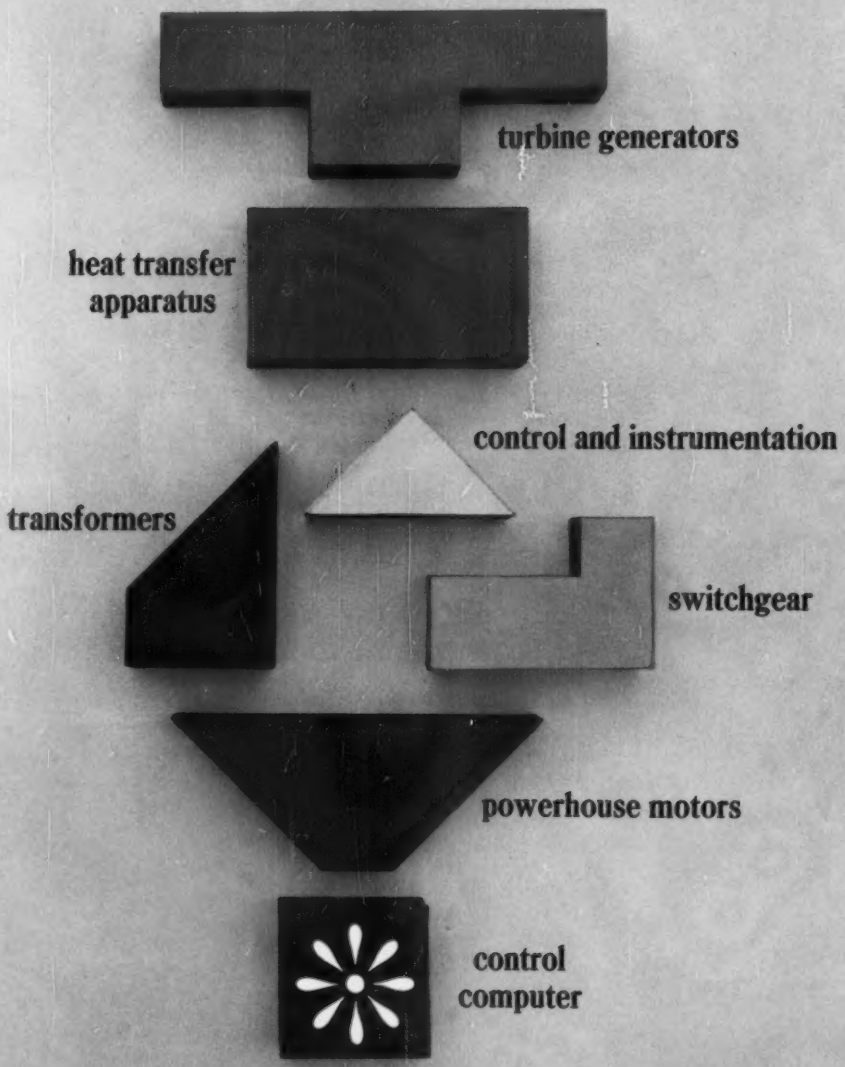
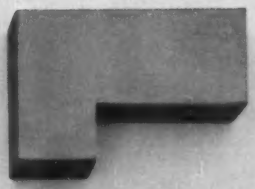
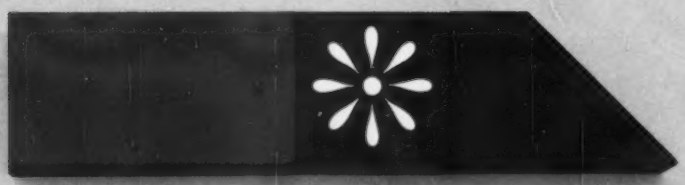


and, based on our analytical and system engineering experience – we can contribute practical advice to help you and your consulting engineer develop your plant design and specifications.

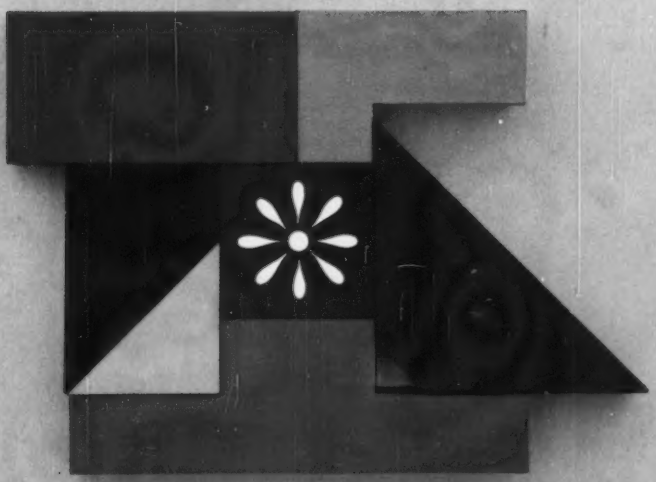
When you have determined the requirements of your power plant, we will furnish proposals on whatever individual equipment you wish...



or any group of equipment...



or all equipment including associated auxiliaries.



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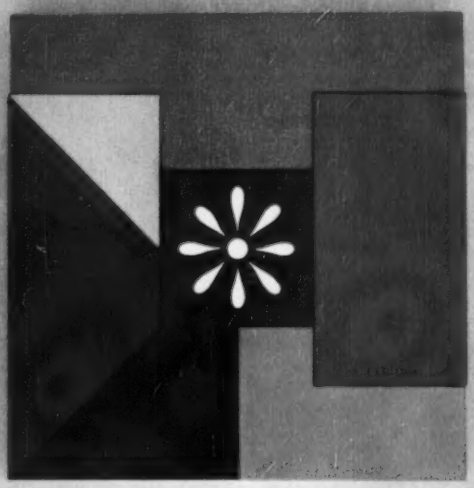

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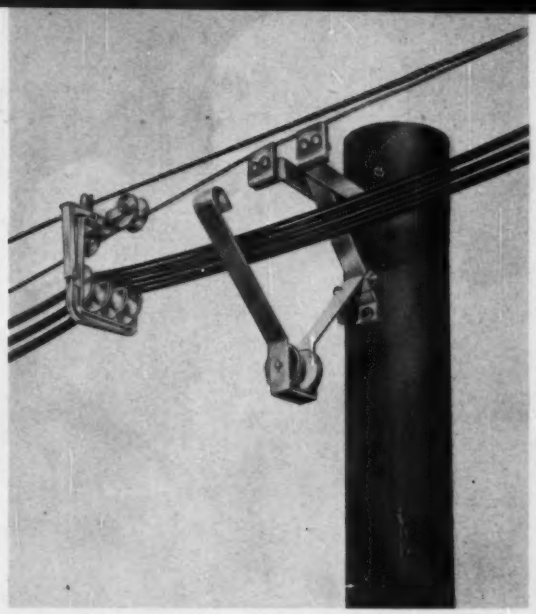
New Equipment

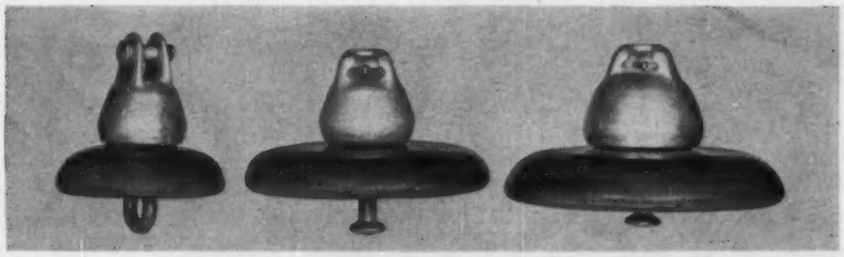
(*Continued from page 60*)

Messenger Bracket . . .



. . . used with messenger traveling block permits "continuous stringing" of spacer-type aerial cable. Bracket, used with aluminum traveling block, Model MT-404, is steel-galvanized and remains as permanent part of installation. Both pole mounting and crossarm mounting messenger brackets are available. The V-shaped slack carrier supports the pulling line. After the stringing operation is completed, the slack carriers are removed for use on subsequent jobs. All blocks are put on at lead pole and ride past intermediate poles without assistance or interruption of pulling operation.

Sherman and Reilly, Inc, First and Broad Sts, Chattanooga 2, Tenn.



9-in. Suspension Insulator . . .

. . . combines the cap-head-and-pin design of a standard 6-in. dead-end insulator (left) with a 9-in.-dia disc to achieve a 14,000-lb combined M & E strength rating. With both the disc and head 1 in. smaller in diameter, it is reported that rated electrical characteristics of the new "Hi-F" suspension, e.g., leakage distance, string flashover (wet, dry and impulse) are the same as existing NEMA standards for a 15,000-lb suspension insulator (right). The new unit, designed for "normal-duty" transmission lines, provides an adequate safety factor for any suspension use up to a working load of 7,000 lbs. Its impact strength of 55 in.-lb corresponds to that established for the NEMA standard 10-in. unit. Weighing about one-third less than the standard 10-in. unit, the suspension element is physically interchangeable with NEMA standard 15,000 and 25,000-lb suspension insulators, since it uses the same ball-socket details.

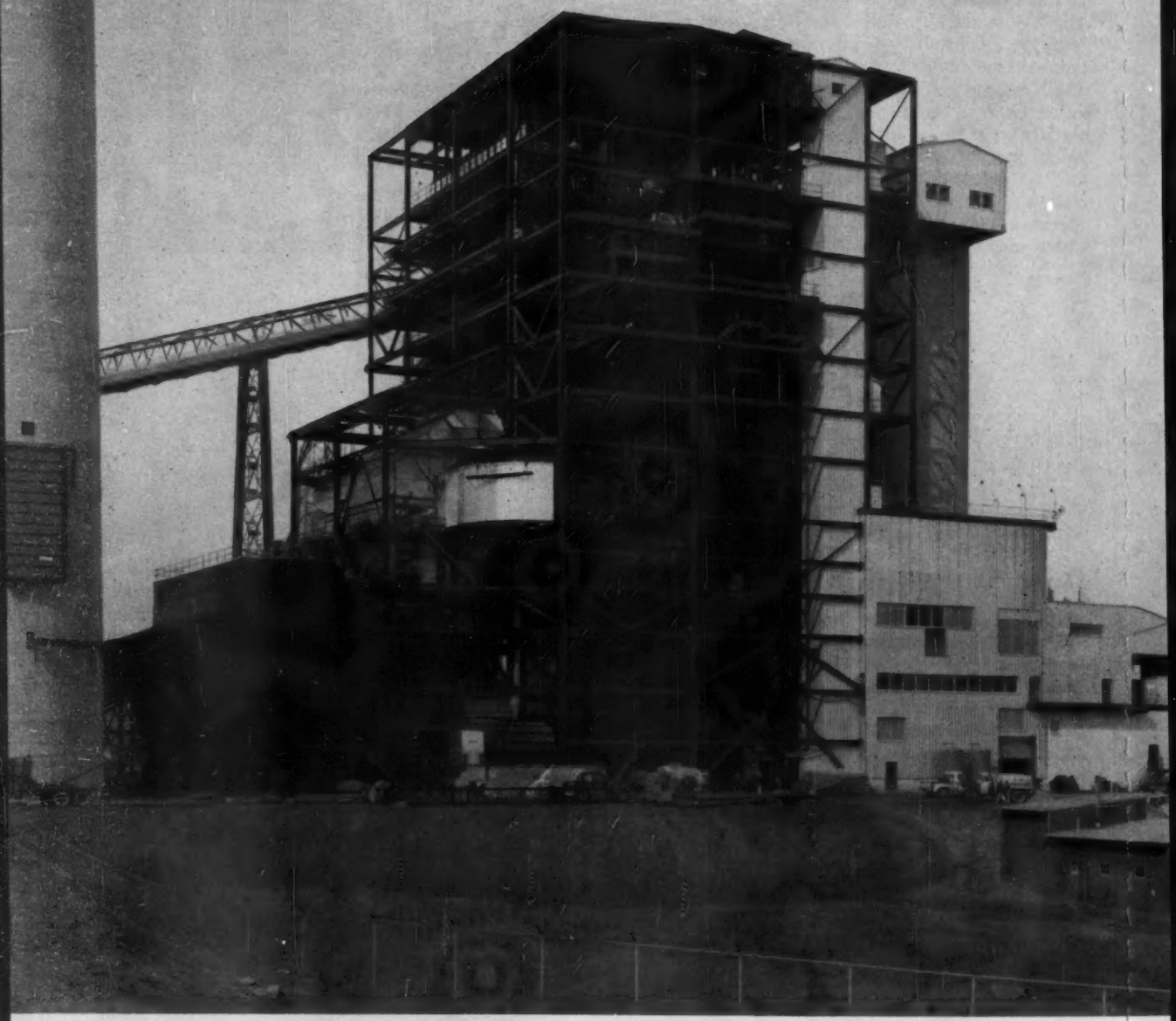
Lapp Insulator Co, Inc, LeRoy, N.Y.

Crane Boom Guard . . .

. . . prevents power-line accidents. Saf-T-Boom will withstand a 5,000-lb drop test, is weather-proofed and laboratory-tested to over 100 kv without bypass or leakage. Installed in a few minutes, the shield does not affect crane operation or the view of the operator. Two models are available: one a 250-lb unit designed for 20-ton and larger cranes, the other a 200-lb unit for smaller cranes.

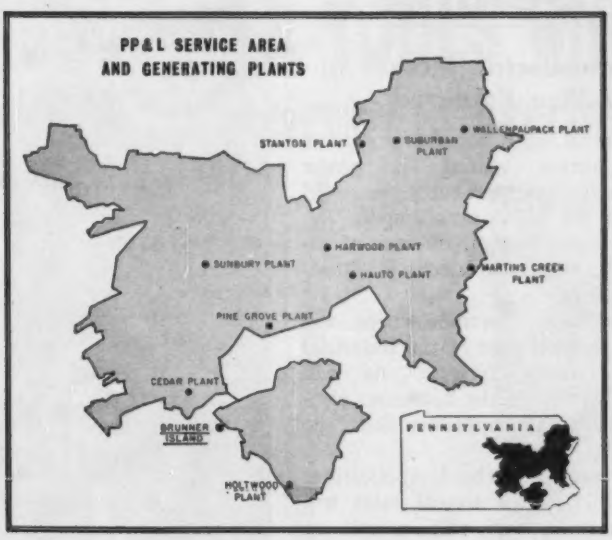
Saf-T-Boom Corp, 1613 Main St, Little Rock, Ark.

BRUNNER ISLAND



Specifications:

Unit	C-E Controlled Circulation radiant reheat type with divided furnace
Primary Steam Flow	2,100,000 lb/hr
Design Pressure	2,750 psi
Operating Pressure	2,500 psi
Superheat/reheat Temperatures	1005F/1005F
Fuel	Pulverized coal
Fuel Burning Equipment	Tilting Tangential burners supplied by 5 C-E Raymond Bowl Mills



New 300,000 kw station goes into service

When Unit No. 1 at the new Brunner Island Steam Plant was placed in commercial operation on June 22nd, Pennsylvania Power & Light Company expanded its system's capability to over 1.8 million kilowatts.

Steam for the 300,000 kw cross-compound, quadruple-flow turbine is supplied by a C-E *Controlled Circulation* steam generator designed for outdoor service. Photograph of the new outdoor station during final stage of erection, and brief specifications, appear on the opposite page.

The Brunner Island unit—largest in PP&L's system—is located on the Susquehanna River at York Haven, Pennsylvania, about fifteen miles downstream from Harrisburg. Ebasco Services, Inc. were the consulting engineers.

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Joppa
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Portsmouth
Lake Creek
Etiwanda
Aurora
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Eastlake
Oak Creek
Suwannee River
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Selling

Thermoelectric Market of $3 Billion Predicted

Annual sales for thermoelectric refrigeration, heating and power generation will probably reach $3 billion by 1970, according to Dr. Robert A. Bernoff, director of research, Materials Electronic Products Corp.

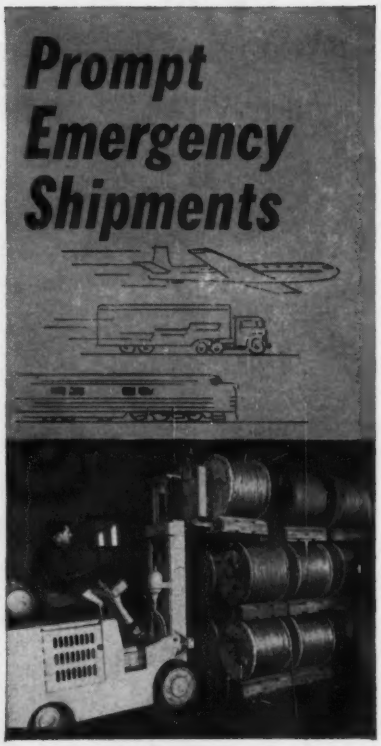
By then, "thermoelectrics will have a good part of the industrial and military markets and will radially change the consumer electric refrigerator-appliance field," he said.

Typical household applications by 1965, when annual sales will reach over $425 million, will include thermoelectric kitchens with distributed cooling in refrigerated drawers, table-top chilling and warming of dishes.

Industrial applications by 1965 will be: Aircraft and truck cooling, cooling for industrial motors, and refrigeration for vending machines.

SELLING BRIEFS

Lower rates have gone into effect for mercury vapor street lights in cities and towns in the Pacific Gas & Electric Co service area. Rates were made possible because mercury vapor equipment now is less expensive and more efficient and because rated lamp life has increased, according to Vice President and General Manager S. L. Sibley . . . **Street Lighting Contest Awards** for General Federation of Women's Clubs have been stepped up by *Readers Digest*. In 1962, 60 awards will be given, compared to six in 1961 . . . **New football-baseball** stadium now being built in Washington, D. C., may be the best lighted outdoor sports facility in the country. Over 2,100 floodlights, each rated at 1,740 w, double the number of lights in the present Griffith Stadium, will be installed. For night baseball the lighting will be 200 footcandles in the infield, and 150 ft-c in the outfield. For football the lighting pattern will give uniform brightness throughout the field. The floodlighting system will require enough electric power to satisfy the needs of 2,180 homes.



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When in need of guy or messenger strand during an emergency, be sure to contact the nearest distributor of ***Crapo*** Galvanized Strand! Substantial stocks are maintained at strategic distributing points throughout the country ready for immediate delivery. Back of these stocks are our own extensive mill stocks of finished strand, and strand in process. If your jobber does not have all of your requirements, he knows he can depend upon us for immediate shipment of popular sizes and grades by air, truck or rail.

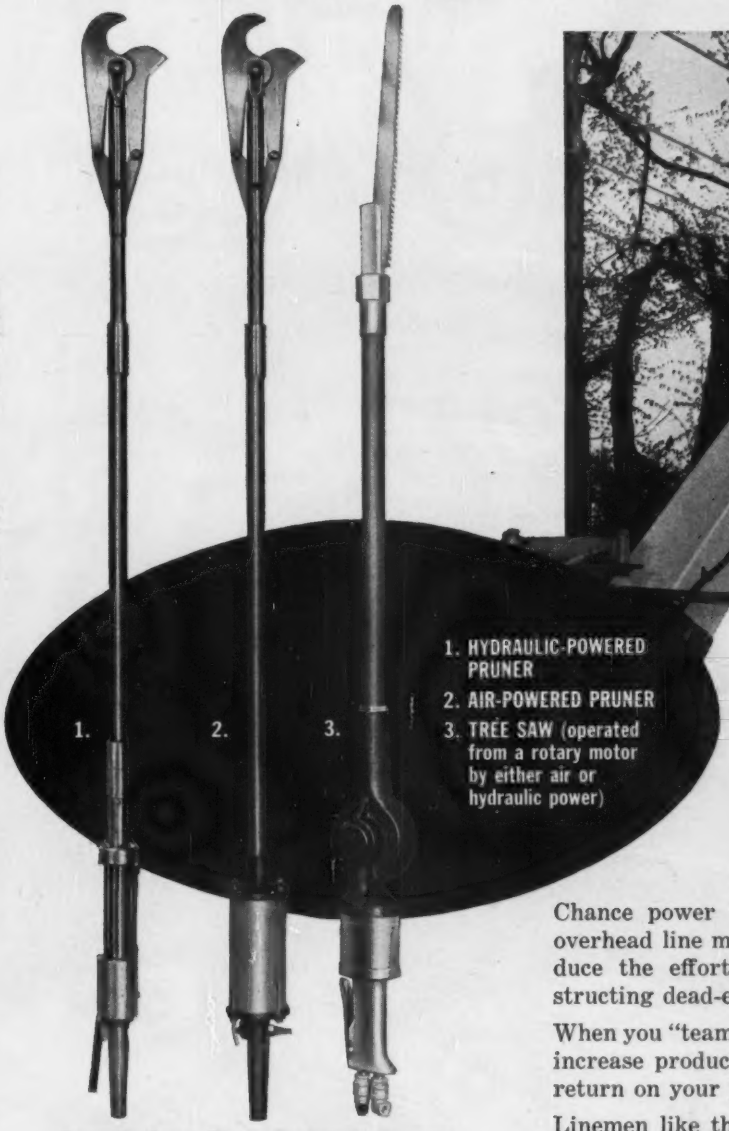
You, in turn, can rely upon ***Crapo*** Galvanized Steel Strand, at all times, to give you the utmost in performance at reasonable cost.

Crapo Galvanized Steel Strand is manufactured in all standard sizes and grades and in three weights of coating: Class A, B and C.

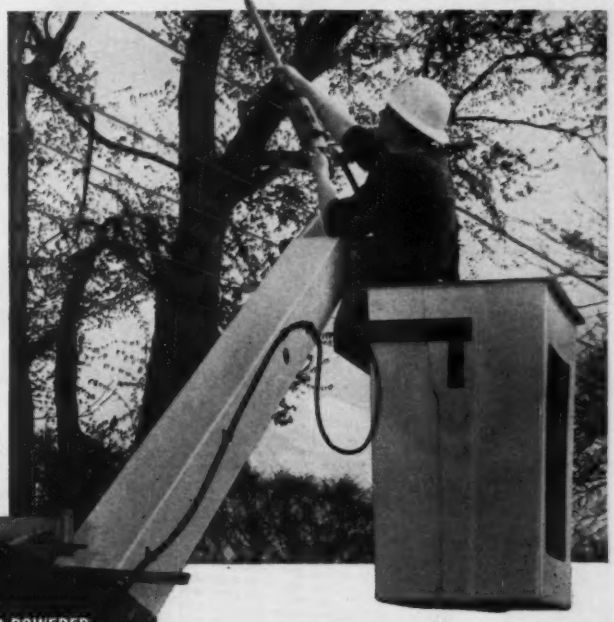
Phone the distributor of ***Crapo*** Galvanized Steel Strand near you the next time you need strand.

INDIANA
Steel & Wire Co., Inc.
Muncie, Indiana

Team POWER TOOLS with POWER LIFTS
. . . for top efficiency in overhead line maintenance



1. HYDRAULIC-POWERED PRUNER
2. AIR-POWERED PRUNER
3. TREE SAW (operated from a rotary motor by either air or hydraulic power)



Mechanization in maintenance saves time and effort

Chance power tools help your linemen "mechanize" overhead line maintenance work. The tools greatly reduce the effort required for cutting, pruning, constructing dead-ends and many other oft-repeated jobs.

When you "team" power tools with your power lifts you increase productivity still more and realize a greater return on your power lift investment.

Linemen like the way these tools complete their task with just a press of the thumb on the trigger. Their light weight makes them easy to handle in buckets or on a pole. And you gain by getting maximum utilization of highly skilled line personnel.

Ask your Chance man for more Power-Tool information, or write for Bulletin 635.

Operate from Air or Hydraulic Power

Two complete lines of Chance power tools are available. Air-powered tools are operated from an air compressor or bottle of CO_2 or dry nitrogen. Hydraulic-powered tools can be operated from the standard hydraulic source of the insulated bucket mechanism, truck "A" frame or winch.

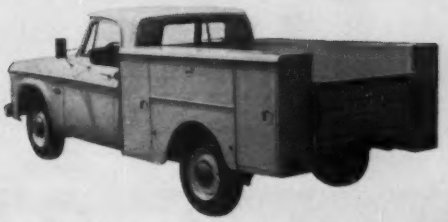
Eight Different Cutting Tools

A wide variety of tools are made for cutting limbs, conductor or strand. Power tool uses include Hook-Over Pruner, Shear-Type Pruner, Tree Saw, Brush Cutter, Guy Strand Cutter, Power-Cable Cutter, Multi-Cable Cutter, and ACSR Cutter.

A. B. CHANCE CO.
CENTRALIA, MISSOURI
A. B. Chance Co. of Canada, Ltd., Toronto CT61-21

DODGE

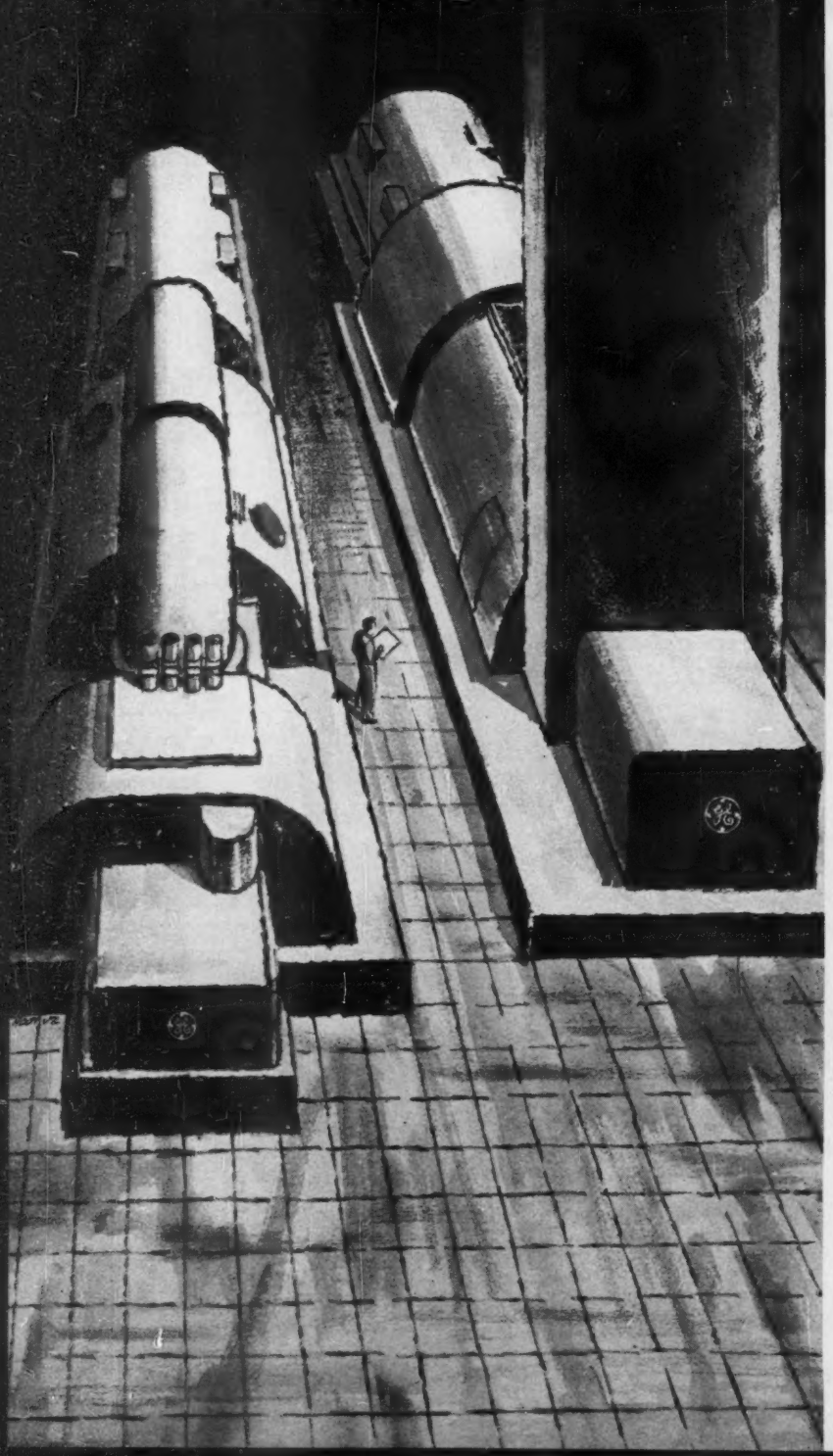
Compact diet. Compact upkeep costs. Compact in everything but work capacity. A full half-ton hauler that'll do the dirty jobs every day, day in and year out. New right down to the wheel studs. New cab. New body. New and easier clutching, shifting, handling. Even a new soft sound. New standard 140 hp. inclined engine that can deliver gas mileage competitive with anything in its field, and do it on regular gas. That's how our tests worked out. And we wouldn't talk about it if you couldn't get the same results. The engine is slanted 30 degrees from the vertical for top-notch manifolding, both intake and exhaust. **THE '61 DODGE LINE?** All Dodge, all tough from end to end. Conventional and cab forward models, four-wheel drive series, Town Wagons for toting men and tools. Six and V8 gasoline power. Cummins diesels. A weight spread of 4300 lbs. GVW to 76,800 lbs. GCW. **PRICE?** The new Dart Pickup and the whole 1961 Dodge line of trucks are priced to compete with every truck coming or going. What more do you want? See your Dodge dealer now!



DODGE TRADESMAN Puts your tools and supplies right where you want them. Vertical and horizontal compartments, with locks, on both sides. Big floor area for your bulky stuff. Offered with all-new Dart Power Six or V-8 power, 2- or 4-wheel drive.

A PRODUCT OF CHRYSLER CORPORATION

New steam-gas cycle=



4% gain in generating efficiency

Oklahoma Gas and Electric Company is pioneering the first large steam-gas turbine-generator combined-cycle installation.

This utility has already logged 12 years of successful operation with two General Electric gas turbines in its Belle Isle Generating Station.

Destined for OG&E's Horseshoe Lake Station, the new 237,000-kilowatt steam-gas cycle addition will be placed in service in 1963. Its maximum design efficiency will be 4% better than a comparable conventional steam cycle. Reason: the dual role of the gas turbine.

First, the gas turbine supplies power for its own generator. With 1600 F inlet temperature it develops 26,450 kilowatts.

And second, its exhaust gases provide high-temperature combustion air to the boiler supplying its steam turbine partner.

The gas turbine can be used in combination with a steam turbine regardless of steam conditions. Through "high-temperature topping" it boosts the performance of the entire plant by increasing the maximum temperature at which power is generated.

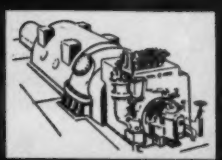
Gas burning combined-cycle power plants employ conventional gas turbines, steam turbines, and boilers available *today* . . . to help reduce the cost of power generation. 244-12

Progress Is Our Most Important Product

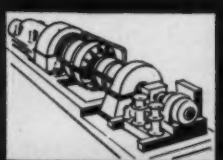
GENERAL ELECTRIC

General Electric Turbine-Generators Help Keep Power Costs Low

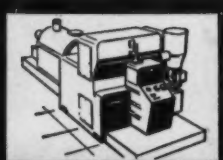
Steam turbine-generators for large blocks of power



Steam turbine-generators 100,000 kw and lower



Gas turbines for peaking, base load, combined cycles



Mechanical drive steam turbines for auxiliaries

Electrical World

JULY 17, 1961

Management Newsletter

COAL

OIL

NATURAL GAS

HYDRO

NUCLEAR

The Future of Fuels—Part II

HOW WILL FUELS BE MINED AND MOVED?

Technology of getting fuel out of the ground and to the power plants fixes to a great degree the future prices of fuels. Electric utilities, which spend one-sixth of their revenue dollars for fuel, are therefore vitally concerned with the job of mining and moving fuels. In this second of a three-part series of articles on fuels, *Electrical World* presents a picture of changes in how fuels will be taken from the ground and transported to power plants.

Many changes in mining and moving fuels will take place in the next decade. Automatic machines will ease the work of coal mining so that men outside can dig coal deep from the heart of the mountain. Railroads will unload cars while still in motion in a shuttle service between coal mine and power plant. And coal pipelines promise startling new developments which represent a breakthrough in coal transportation. These, and other technological changes, promise to do much to hold down electric utility fuel costs.

KING COAL MECHANIZES

King Coal is striving to increase output per man-day, and he is succeeding. Today, the average miner produces 13 tons of coal each working day, more than double the 1947 production rate. By 1975, this could hit 20 tons, if the progress of the past ten years continues. How is this being done?

Mainly it is being done by mechanization. Fully 95% of today's underground coal is cut, drilled, blasted and loaded by machines. Today's miner no longer shovels coal; instead, he runs machines which enable him to turn out more coal with less manpower. On surface mining, much the same picture can be drawn. Huge power shovels, draglines, and wheel excavators cut through 100 ft of earth to expose the coal seam. Consistently, year-by-year for the past ten years, these new machines have raised output per man-day.

What can electric utilities look forward to from the coal mining industry? Even newer machines will be used to increase output per man-day. The continuous miner literally chews coal from the seam and loads it at the rate of eight tons a minute. Shovels of huge size are now being built. The largest, taking 20,000 hp, will pick up 173 tons of overburden, dump it 450 ft away, and swing back for the next bite in 50 sec. Even more startling is the remote-controlled miner, operated from the surface by a single man. While such a machine is still in the development stage, its operation should measurably increase the per man-day coal output. What does this mean to electric utilities?

Clearly, the future points to giant steps in production per man-day, at least as large as the past ten years. As more and more of these machines are put to use, production per man-day will continue to rise. As a benchmark on how far production can go, one deep mine today is producing 45 tons per man-day. These machines clearly demonstrate the fast-changing technology of the coal industry, but what about the competing fuels—gas and oil?

WELLS GO DEEPER FOR GAS AND OIL

Wells for gas and oil are being drilled deeper and deeper. Last year, a well was drilled to over 25,000 ft, three times the record of 30 years ago. More than 228 wells were drilled over 15,000 in 1959 compared to five in 1950. But here too, technology is working to hold down costs.

Novel drilling techniques will be used in the future. One, presently being experimented with, is the use of sound to vibrate the drill bit at a low frequency, thereby cutting the rock. Another, recently introduced into US operations, is the turbodrill where fluid circulated through the pipe from the surface drives a turbine and bit at the bottom of the hole. The turbodrill will probably be used more in the future since its advantage relative to other drills increases with depth.

But the oil and natural gas industries must work hard to hold down costs. Both are being forced to drill deeper and in more remote areas to find new reserves. Present drilling and discovery techniques seem to be on a plateau and are not finding fuels fast enough. However this is being overcome by better processes for recovering more oil and gas from existing fields and from offshore operations.

Oil and natural gas obviously do not present the fascinating future that coal does to the electric utility industry. They contain more question marks, both in their future reserves and the technology of finding more oil and natural gas. So does the newest energy source, uranium, but this metallic fuel is destined to take a big piece out of the market.

URANIUM ADVANCES STEADILY

Uranium fuels remain expensive but are still rapidly becoming more practical, both in cost and operation. Political factors are and will continue significant, but technological development will provide the decisive margin for competition. With nuclear fuels, it is not in the mining operation that the largest cost reductions will occur, but rather in fabrication of the refined fuel material—uranium dioxide in most cases—into fuel elements.

New methods of compacting and cladding UO_2 are making fabrication adaptable to volume production. Manufacturers are developing new fuel compounds and alloys that outperform uranium dioxide. Better fabrication and better fuel material should yield fuel elements able to stand up well in reactors to give longer burnups. And gas centrifuging stands on the horizon with its potential for cheaper fuel.

Just as important as getting the fuel from the ground is that of transporting it to the power plants. Coal pipelines and extra-high-voltage transmission provide the more startling examples of progress in fuel transportation. But the railroads continue to haul the major part of coal used in this country.

RAILS FIGHTING HARD

The "railroad problem" seems to be a paradox. On the one hand, A. E. Perlman of the New York Central System says that "by every law known to physics, the railroads should be out-performing, out-hauling, out-earning any other form of transport known." John Barriger of the Pittsburgh & Lake Erie Railroad Co claims that "railroads are the most efficient agency for most transportation tasks. They use but one-sixth the manpower and one-third the fuel that trucks require for the same amount of work. Their average cost per mile is one-fourth that of trucks." But instead, many have been writing off the railroads as a dying relic of the early history of this country.

Rails are working hard to improve services and reduce costs. Dieselization is

perhaps the outstanding example. The coal industry can tell you much about the effects of the very rapid pace of railroads changing to diesels. But many other less spectacular changes are being made. The Norfolk & Western Railway, hauler of 14% of US coal, stepped up coal train movement from mine to piers from 30 hours a decade ago to 12 hours. This railroad now has an average age of 3.2 years for its diesel fleet. The Louisville & Nashville Railroad is experimenting with 100-ton cars which unload while the car is still in motion. This speeds up the return of the cars and enables them to increase their plant utilization factor. New push-button classification yards are being built. One railroad has four such yards which replace 25 older yards and can cut car delays as much as 70%.

Rails are not going to take coal pipeline and extra-high-voltage transmission competition without putting up a fight. They are determined to haul much more coal for electric utilities. Bulk transportation of coal is the type of work they want to do, probably because it carries the highest rate of return. A midwestern railroad expects to double its utility coal shipments by 1965. Many rails will try to haul much of the bulk-cargoes in so-called shuttle trips where cars are in effect dedicated to one rail route, for instance from mine to power plant. In this manner, turn-around time can be minimized, and car and diesel utilization can be increased substantially. A train dedicated to one use can have a turn-around time of less than a week compared to average turn-around time of two months.

Clearly, rails are trying hard. But they're not succeeding. Why? It seems that the chief difficulty lies not in the technology of railroads but in operating flexibility. The railroads today clamor for freedom to manage their own affairs. They want the right to determine manpower for train crews. One top railroad executive claims that in Europe, even under government operation, train and engine crews have as little as one-third the number of men union requirements force upon railroads here. One can see good potential for cost reduction here since labor makes up a substantial part of railroad costs. Rails imply that they want freedom to seek and carry high-volume bulk freight in shuttle services.

The next decade will see hard fighting by railroads, fighting to hold the bulk customers—the very ones threatened by coal pipelines and high-voltage transmission. Every time a utility proposes a pipeline or a mine-mouth plant, the rails will be knocking at the door to find out what they can do to hold the customer. And at the same time, trucks and barges want to haul utility coal too.

TRUCKS, BARGES GROW BIGGER

Trucks of 200-ton hauling capacities will soon be used to haul coal on specially built roads from mine to power plant. On general highways, trucks have taken to using aluminum bodies in efforts to increase pay load. This type of improvement has enabled trucks to haul one-eighth of total US coal production but, even so, this percentage has changed little in the past ten years. A danger to the future of coal trucking is the objection of some communities to hauling coal through their town. But barges don't have this kind of trouble.

Steadily though slowly, barges progress. Today's riverboats carry up to 26,000 tons. Waterways are being renovated and new ones are proposed. The Ohio, already congested with 80 million tons of traffic a year, is being renovated with 1,200-ft-long locks to replace the old 600-ft locks. New waterways are proposed to tie the Atlantic to the Gulf across Florida and to connect the Tennessee Valley with the Gulf at Mobile.

COAL PIPELINES VERY MUCH IN PICTURE

Coal pipelines, the most radical change in coal transportation in recent years, are being considered by many utilities. An *Electrical World* survey of only 25 electric utilities netted six who were considering coal pipelines among other new-to-them transportation methods.

Why are so many studying pipeline transportation of coal? Primarily because coal pipeline technology proceeds at a very rapid pace. Tomorrow's coal will be piped

not as a 50-50 mixture of water and coal which cannot be stored but as a 65-35% mixture which can be stored because the coal will stay in suspension. This means that the same pipe can carry 30% more coal thereby reducing transportation costs appreciably. But just as important, the mixture can now be stored indefinitely and be burned like a liquid fuel. This eliminates the expensive de-watering plant at the receiving end and permits stored coal to be kept in tanks. This stabilized slurry can be burned in cyclone furnaces and, with certain adaptions, in present-day pulverized fuel plants.

Consolidation Coal Co is studying new pipeline routes and is making contacts for these lines as rapidly as possible. Still under discussion is the 400-mile, six-million-ton line from southwestern Pennsylvania to eastern seaboard utilities. Another is the proposed 250-mile, four-million-ton pipeline from southern Ohio to northern Michigan, near Detroit. This line is being fought strenuously by the rails who are determined to meet the competition. Still another is a proposed line from Utah to Los Angeles and San Francisco. This would be a 600-650-mile, six-million-ton a year line. Finally, two other pipelines are being considered. Coal pipelines seem to present a challenge to rails. How about oil and gas pipelines?

GAS-OIL PIPES CHANGE SLOWLY

Gas and oil pipelines show progress on new compressor techniques, new control concepts and higher strength pipes. A 50% increase in pipe pressures is producing economic gains even though it requires more compression and stronger pipes. Jet engines are being used to drive compressors, many of these are remotely controlled. But most interesting to electric utilities is the carry-over of electric power dispatching techniques and concepts into the gas pipeline industry. Presently this involves the analytical approaches to performance of pipelines. Eventually it may follow electric utility automatic load dispatching systems rather closely. Generally, gas-oil pipelines present a picture of slow and steady progress but nothing as fascinating as extra-high-voltage transmission.

EHV PROMOTES MINE-MOUTH PLANTS

Extra-high-voltage transmission has made the carrying of fuels by wire appreciably more economical. The sudden surge of the past five years into 345-kv lines is already having effect on the number of mine-mouth plants in the US. Two American Electric Power Co plants, Breed and Clinch River, fall close enough to the mine to be called mine-mouth plants as does the Four Corners Plant of Arizona Public Service Co. Others may follow.

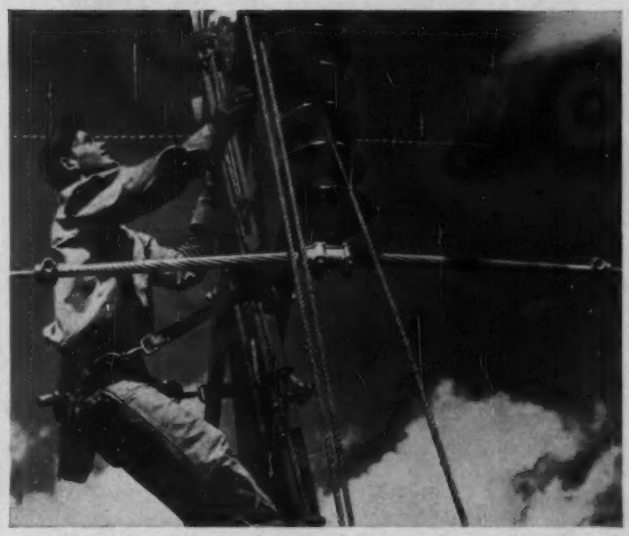
As electric utility men well know, transmission technology is going well beyond the 345-kv class. Within a decade, 500-kv lines will begin to be built in various sections of the country. This should be followed by 700-750-kv lines before 1980. These jumps in transmission voltage will reduce costs still further and promote the building of more mine-mouth plants. The number of such plants will depend on the future relationship of transporting energy by wire, pipeline and railroad. They will be limited by other factors, however, such as the desire of many electric utilities to have their power plants at home, where their customers are.

One transmission authority says that each mine-mouth plant is an individual, specific economic problem. He claims that simple rules such as mills per kwhr per transmission mile are to be viewed with a high degree of caution. Moreover, mine-mouth plants involve other considerations such as interconnecting with neighboring utilities, or the utility desire for inflation-proof transportation of part of their fuel needs.

As you can see, the technology of mining and moving fuels presents a varied picture. In coal and transmission, a fascinating future can be painted. In others, the future is more prosaic. Since technology in part fixes prices, one is inclined to ask about future prices. This will be discussed in the next Management Newsletter.

ALCOA ALUMINUM
ACCESSORIES ROUNDUP

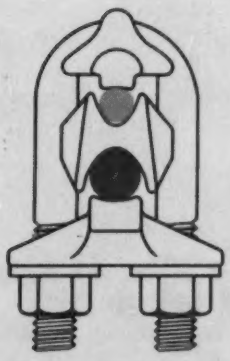
Alcoa Tapered Armor Rods provide two-way protection



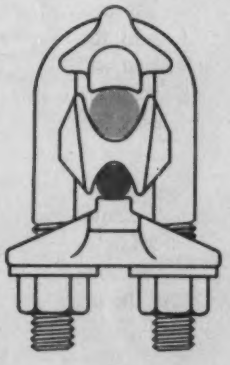
Armor rods protect transmission conductors in two important ways. First, and most obvious from a functional point of view, is *mechanical* protection and reinforcement at the point of support. The rods serve as a definite barrier to abrasion and to damage that might occur as a result of flashover and arcing.

Even more important—tapered armor rods give more protection against damaging *vibration* than any other type of rod reinforcement. In most cases, this protection is sufficient to eliminate the need for any additional damping devices. As a result, tapered armor rods can provide substantial savings.

Tapered rods act to reduce vibration both in amplitude and in total number of hours during which vibration occurs. Reduction in amplitude significantly lowers the cyclic bending stresses on the conductor and reduces fatigue. Reduction of the number of hours during which vibration occurs further lessens the possibility of damage. Although it takes a little more effort on the part of linemen to install tapered rather than other types of rods, the results are worth it. Time can be saved during installation by placing the complete set of rods in the wrenches on the ground, since all the rods are applied simultaneously. Alcoa makes and stocks a complete range of armor rods for ACSR and stranded aluminum conductors. Get all details from your nearest Alcoa-Rome representative.



CAT. 582·1



CAT. 581·2

Aluminum over copper...every time

Copper conductor, whether larger or smaller than the aluminum conductor to which it is being connected, can now be placed—as it should be—*below* the aluminum. The 580 series of U-bolt clamps has been supplemented to provide alternate positioning of grooves (see illustration). You can install this Alcoa clamp so that the open end of the bolt and nuts face downward for ready accessibility with hot line tools.

In addition, the upper limit for the No. 3 groove has been revised to include 795 MCM 26/7 ACSR and 1,000,000 CM stranded aluminum conductors. Complete details on delivery are available from any Alcoa-Rome representative.

(Continued on next page)

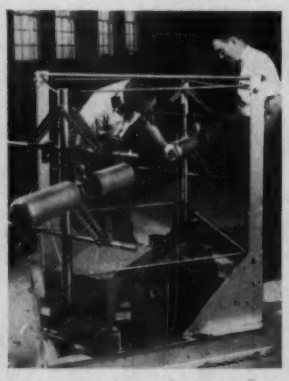
New Alcoa Service Entrance Connectors

CONDUCTOR SIZES						Wt. in Lbs. Per 100 Pieces	Cat. No.
"A" End			"B" End				
ACSR	AWG	Color Code	ACSR	AWG	Color Code		
2-6/1	2 Str.	Red	2-6/1	2 Str.	Red	2.9	791
			4-6/1 4-7/1	4 Str. 4 Sol.	Orange	3.0	792
			6-6/1	6 Str. 4 Sol.	Blue	3.1	793
4-6/1 4-7/1	4 Str. 2 Sol.	Orange	4-6/1 4-7/1	4 Str. 4 Sol.	Orange	3.2	795
			6-6/1	6 Str. 4 Sol.	Blue	3.2	796
6-6/1	6 Str. 4 Sol.	Blue	6-6/1	6 Str. 4 Sol.	Blue	3.3	798

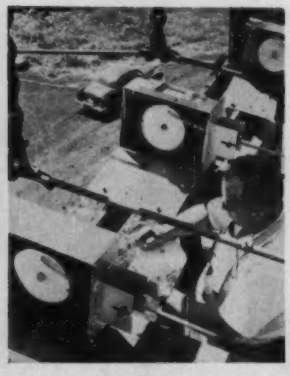
Pictured above is one of the Alcoa® 790 series service entrance connectors, and we feel sure you'll agree that they have all the features connectors need. End caps are color coded to industry color standards. The caps are made of thin aluminum, are easy to puncture with the wire, and hold the conductors while compressors are applied. Both barrels are filled with a joint compound having a melting point above 550°F, and each connector is clearly marked with easily readable identifying data. Installation of these connectors can be made with a variety of compression tools. Bore lengths are proportional to conductor size, and there's an integral solid barrier between bores. The new 790 series service entrance connectors are top-performance "Class A" connectors. They come 50 to a box. Get all the details from your usual source of Alcoa materials.

Research at Alcoa

Some projects assigned to our researchers go on continuously, over long periods of time. For example: Since the late 1920's, part of Alcoa's extensive facilities at Massena, New York, has been devoted to developing, testing, and establishing application data for dampers and other vibration protective devices for mechanical protection of overhead conductors. We regularly provide customers with engineering data and recommendations based on our findings. We'd be happy to discuss specific situations through local Rome Division salesmen.



Every new design in Stockbridge dampers is subjected to tests for fatigue resistance. This apparatus can create any desired frequency and amplitude of vibration desired.



Alcoa's outdoor test facilities at Massena, N. Y., include two towers with 1500-foot span; two sets of H-frame structures with 1000-foot spans; and two H-frame structures with 400-foot spans.

Summing up:

Alcoa tapered armor rods protect transmission conductors in two ways. They reinforce at the point of support and provide excellent protection against damaging vibration.

New 790 series service entrance connectors are designed for quick, easy, efficient handling and installation.

Alcoa research on vibration protection is one phase of an extensive program aimed at providing basic data about, and optimum performance from, transmission accessories.

Supplemental design for U-bolt in 580 series clamp lets you position aluminum over copper—every time—no matter which conductor is larger.

Your nearby Alcoa-Rome representative is eager to supply full details on any or all of these items. Why not call him today?

Catalog of Tubular Accessories

Contains tabular data and catalog information on all Alcoa® tubular accessories. Also includes sketches of all accessories as well as installation instructions. For a copy, write Rome Cable Division of Alcoa, Rome, New York.

ALCOA
ROME CABLE
DIVISION

This is an advertisement.

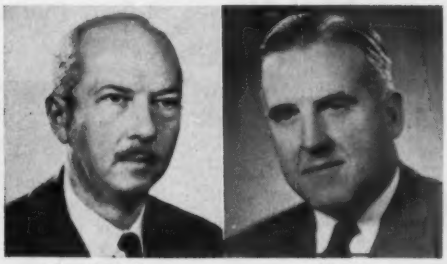
Hartford Utility Promotes McCormick to VP

Joseph R. McCormick has been elected vice president of Hartford Electric Light Co.

McCormick joined the company in 1935 following graduation from the University of Connecticut. After starting in the accounting department, he served in the sales department until 1952 when he became public relations assistant. In 1958 he was appointed public relations director.

McCORMICK

Kelly Named Chairman; Ginn Succeeds Him as President



KELLY GINN

McClure Kelly has been boosted to chairman of Baldwin-Lima-Hamilton Corp and William S. Ginn has been named to succeed him as president.

George A. Rentschler resigned as chairman. He retired from active participation in company business, but will continue as chairman of the executive committee.

Andrew Liston was appointed vice president and general manager of the industrial equipment division at Eddystone, Penn. Frederick A. Fielder became corporate vice president for sales.

Kelly has been president since 1955. Ginn was formerly a General Electric Co vice president.

PERSONAL BRIEFS

Jack N. O'Neal is the new Portland area manager for Bonneville Power Administration. He succeeded **William A. Galbraith** who became BPA's power marketing specialist in the power management division.

At Consumers Power Co, **Russell C. Youngdahl** has moved into the general office as assistant general supervisor of electric distribution. **Howard J. Jensen** succeeded him as electric distribution superintendent in Flint, Mich. **George D. Stevens** became electric distribution lines general supervisor and **Elmer M. Syrjamaki** was named distribution substations general supervisor.

Richard D. Wilhite, vice president of Orange & Rockland Utilities, Inc, has been elected a director.

Arizona Public Service Co has appointed **Thomas G. Woods** Four Corners project construction manager. **Harold Taylor** succeeded Woods as distribution engineering supervisor.

President of the Illuminating Engineering Society for 1961-'62 is **James R. Chambers.**

The following have been elevated to the grade of Fellow in American Institute of Electrical Engineers: **Charles F. Green,** visiting professor of electrical engineering, Cornell University; **Harold R. Heckendorn,** superintendent, manufacturing engineering, Western Electric Co; **Gordon F. Tracy,** professor and head of the electrical engineering department, University of Toronto, Canada; **Noel E. Dillow,** general manager, bushing products section, power transformer department, General Electric Co; and **Arthur L. Samuel,** research communications director, International Business Machines Corp.

Kenneth S. Cosseboom has been promoted to chief engineer of Bangor Hydro-Electric Co. **Kenneth S. Cosseboom Jr** succeeded him as field engineer.

Bureau of Reclamation has appointed **John W. Mueller** power division chief, succeeding **D. S. Campbell** who was transferred to Denver.

Jules Steinberg has been elected executive vice president of the National Appliance & Radio-TV Dealers Assn.

General Electric Co has named **Dr Lamar P. Bupp** manager of its Vallecitos atomic laboratory. He succeeded **Dr Ralph D. Bennett** who retired. **Dr W. Kelly Woods** became manager-programming for the Hanford laboratories. A nuclear control engineering unit was formed within GE's industry control department, Salem, Va. **Howard J. Wulfken** was

appointed manager of the unit.

Chase Brass & Copper Co, subsidiary of Kennecott Copper Corp, has boosted **William F. Aylard** to vice president. He will be responsible for coordination of the research, engineering and product development divisions.

Minneapolis-Honeywell Regulator Co has boosted **Frederick G. Miller** to operations director in the electronic data processing division. He succeeded **John R. Lenox** who became a vice president of the EDP division. **James M. Cunnien** was promoted to engineering director for the precision meter division, succeeding **E. S. Maury** who resigned.

Robert W. Andrews, vice president of Brown Co, will retire in October.

R. J. Gawronski has been appointed a field engineer for Line Material Industries, McGraw-Edison Co.

William Rudloff has been named acting manager of the heat transfer department of Westinghouse Electric Corp's steam division. He succeeded **David Fulton** who was given a term assignment as general manager, heavy apparatus, in Canadian Westinghouse Co, Ltd.

P. R. Mallory & Co, Inc, has made **W. K. Morga** manufacturing manager for the metallurgical company division.

W. W. Gould has been promoted to nickel-iron battery market manager of Exide's industrial marketing division. The division is the national sales and service arm of Electric Storage Battery Co's Exide industrial and nickel-alkaline battery divisions.

Gould-National Batteries, Inc, has promoted **E. I. Whyatt** to vice president-administration and **H. A. Gregg** to assistant secretary.

OBITUARIES . . . William Welch Jr, 56, vice president in charge of engineering, purchasing and stores for Long Island Lighting Co . . . **Max Rubenstein,** 69, consultant-governmental agency sales, Washington offices of Anaconda Wire & Cable Co.

Westinghouse Appoints Conley VP

Westinghouse Electric Corp has elected Dr Patrick Conley vice president with responsibility for industry engineering apparatus, service and the newly created industry systems department.

The new department will be responsible for the conception, development, design and sale of complex systems for control of industrial processes.

Bischel Is Promoted at Wisconsin Electric Power

Harry W. Bischel has become chief electrical engineer in the engineering department of Wisconsin Electric Power Co's Racine general office. He is in charge of all electrical engineering functions of the extension system.

Beeman Is Commonwealth Ed Purchases Director

BEEMAN

Glen W. Beeman has succeeded the late Robert B. Gear as purchases director of Commonwealth Edison Co. Beeman will continue as fuel agent.

Union Carbide Picks Two To Become Executive VPs

William M. Haile and Kenneth Rush have been elected executive vice presidents of Union Carbide

HAILE RUSH

Corp. Haile also became a director.

Haile joined Union Carbide in 1925 with Linde Co. He was president of this division from 1957 to 1959. He has been a corporation vice president since 1959.

Rush, a director since 1958, has been with Union Carbide since 1936. He has been a vice president since 1949.

GT&E Names Lt-Gen Byers VP-Washington, D. C.

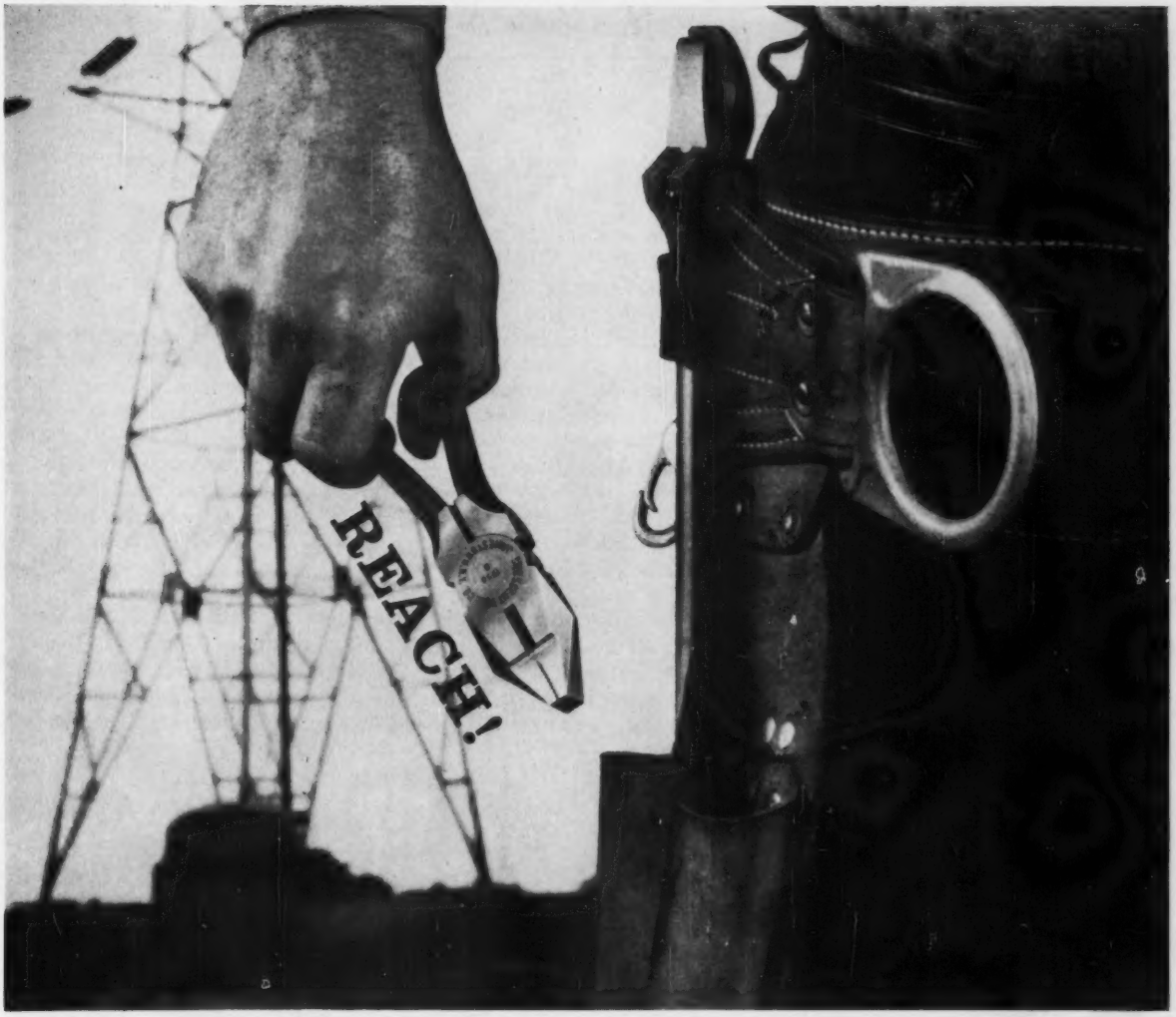
BYERS

Lieutenant-General Clovis E. Byers, US Army (Retired), has been named vice president-Washington, D.C., office for General Telephone & Electronics Corp. He will be responsible for coordination of relations with the federal government. He succeeded Rear Admiral Frederick J. Bell, US Navy (Retired), who resigned but will continue as a consultant.

Anderson Named EDP Division VP-Engineering

ANDERSON

Minneapolis-Honeywell Regulator Co has appointed John W. Anderson vice president of engineering for the electronic data processing division. He succeeded J. Ernest Smith who was named vice president of the EDP division. Anderson has been with Minneapolis-Honeywell since 1941. His most recent position was that of general manager of engineering.



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News Scope

NAME-CHANGE—Southern Nevada Power Co has changed its name to Nevada Power Co. Shareholders recently approved the change and an increase in authorized common stock from 1.5 million to 2.5 million shares. The new name was considered more descriptive of the company since it extended operations into northern Nevada through merger with Elko-Lamoille Power Co in February.

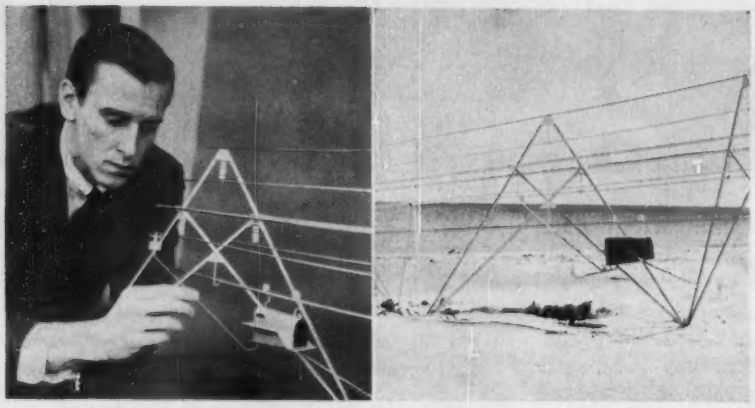
USSR TOP GOAL—Full electrification of the Soviet Union is that country's No. 1 scientific goal, the new president of the Soviet Academy of Sciences, Mstislav Keldysh, declared recently. He gave rocket research a much lower priority than electrification. No mention was made of when full electrification might be achieved, but plans call for electrification of all state and collective farms by 1966. Emphasis on electrification underscored a recent *Tass* report that a substantial part of the country was still without electricity.

SUIT—A $1,050,000 suit by Country Squire Motel against Power Authority of the State of New York for erecting a power line on its property is the largest of 72 suits launched against the proposed east-west line to connect PASNY's Niagara and St. Lawrence power projects. Property owners have filed suits for a total of $4.7 million against the Authority.

MERGER — California Oregon Power Co merged into Pacific Power & Light Co at the end of June. The merger, under review for six months, became effective June 21 with the filing of corporate documents certifying that all necessary authorizations by stockholders and regulatory commissions had been obtained.

THREAT—Tennessee Valley Authority is threatening to sue Tupelo, Miss., and terminate its power contract. The threat, by James Watson, TVA power marketing division director, is in response to a remark by Mayor James L. Ballard that Tupelo is not interested in deducting sales tax paid on power from the tax equivalent paid by the city light department. TVA contends Tupelo is violating its contract by assessing a 2% sales tax on power bills and thus collecting about $8,000. Contracts with power companies call for tax equivalents to be paid to the city by the distributors in lieu of ad valorem levies.

IN OPERATION—Second of two 320-Mw generators at Public Service Electric & Gas Co's Mercer Generating Station has gone into commercial operation. The two units are the largest in operation in New Jersey.



Student Designs Multi-Purpose Line

Oil, gas and a monorail vehicle may be transported via transmission lines in the future. Multi-System, the concept which won David L. Haas (photo left) an Alcoa Student Design Merit Award, would add to lines' functions and thus cut costs two ways: (1) Capital base of tower costs would be spread to other functions, and (2) Costs for right-of-way access roads would be eliminated because workers in the maintenance/construction monorail car could build new towers from the car, by working at the end of the line.

The Multi-System features (from top to bottom, photo at right) a ground wire, one-phase wire, two parallel pipelines, two parallel phase wires, and a monorail.

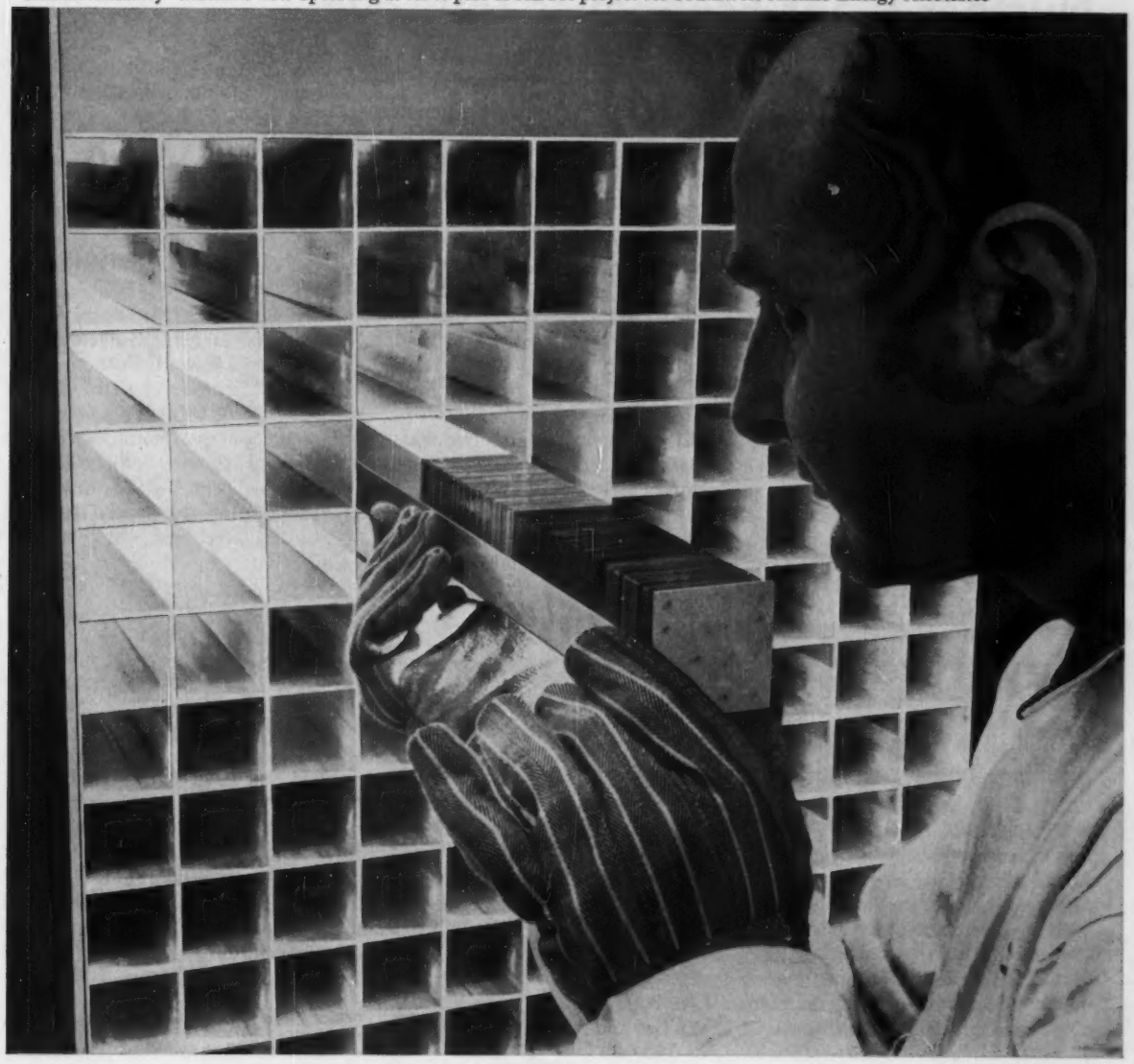
Haas is one of six students selected by the industrial design faculties of their schools for outstanding class projects using aluminum.

DC Transmission Urged For Canada's Peace River

The use of direct-current transmission lines to carry power from Canada's Peace River project in the Pacific Northwest to industrial southern Ontario has been advocated by H. Lee Briggs, member of Canada's National Energy Board. As visualized by Briggs, these lines would carry the power directly, without any injection along the way. This would be necessary because the high cost of facilities to inject power would make the project economically unfeasible.

Briggs also explained that the export of power to Ontario was dependent on Peace River power being developed more cheaply than it could be in Ontario by thermal or nuclear plants, and was also dependent on direct-current transmission becoming feasible. He admitted that the plan would involve a great deal of work but said Canada should launch an early and intensive research program to develop necessary conversion and control equipment.

"Critical assembly" machine now operating at AI is part of AETR project for Southwest Atomic Energy Associates



The Peaceful Atom

Needed in ten years: 100% increase in world power output

In the dynamic decade ahead, the demand for electrical power will be expanding faster than ever before. To meet this vastly increased need, new and highly advanced concepts are needed. A promising nuclear concept is the Advanced Epithermal Thorium Reactor. The AETR is under active study today by Atomics International for the Southwest Atomic Energy Associates, fifteen investor-owned utility companies. Two other nuclear concepts pioneered by Atomics International are being applied in construction of power stations in Piqua, Ohio, and Hallam, Nebraska, as part of Atomic Energy Commission programs. These are some of the ways AI is helping the power-producing companies of the world double the supply of electricity in the next ten years.

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Nuclear Plant Economics Improve

Output boost to 70 Mw seen for Humboldt Bay. Isolated BWR plants to use internal combustion for emergency power

■ Papers on nuclear power were generally in the utility engineer's line of interest. The economics of Humboldt Bay Nuclear Unit were reported optimistically by J. O. Schuyler and J. W. Colwell, Pacific G&E, who predicted that operation of the nuclear unit would reduce steam-plant generation by 470 million kwhr annually. "The expected saving in system fuel cost by generating these kilowatthours with the nuclear unit would offset the annual charges on the additional capital cost of that unit, plus nuclear insurance," they said. The authors also revealed plans "to increase the capacity of the unit to 70,000 kw."

The first core for Humboldt Bay, now under construction, is expected to cost not more than $3 million and is warranted for 10,000 Mw-days per ton of uranium, they continued. A second core should cost less than $2 million with increased exposure to 15,000 Mw-days per ton. Capital cost of the plant is estimated at $20 million.

Emergency power for two widely separated boiling-water reactor plants will be supplied from generators driven by internal combustion engines. At Elk River, Sargent & Lundy's D. C. McClintock told his audience, a gasoline-driven 50-kw unit will automatically supply such critical loads as reactor control-rod drives, the station battery's charger, and reactor decay-heat pumps for the natural-circulation plant. The battery is a further backup and supplies control power, for instance.

The other plant is BONUS, for which Jose Matos, Puerto Rico Water Resources Authority, Frank Bevilacqua, General Nuclear Engineering, and Edward Bottum, Jackson & Moreland, reported that a standby diesel will supply two cooling water pumps for forced-circulation. This standby unit will also serve a load center for 15 valves and turbine turning gear as well as emergency lighting and other needed equipment.

New Hydro Plants Turn to Pump Storage

Cowans Ford designed for remote-controlled peaking. Niagara Project to store 240 Mw

■ Papers on the Cowans Ford and Niagara power projects dominated the hydro generation session. Though vastly different in size and function, both projects involve pumped-storage—in the case of Cowans Ford for peaking exclusively, but at Niagara to supplement base capacity.

J. Q. Wray's paper on Duke Power Co's Cowans Ford Project explained that the plant will have an initial three-unit capacity, in 1963, of 262,500 kw and an ultimate four-unit capacity, after 1965, of 350,000 kw. Load factor will be 4.5%. System capacity in 1965 is estimated at 3,900,000 kw.

The pump-turbines are adjustable-blade Kaplan type rated 121,000 hp at 92 ft head, 105.9 rpm and with an average efficiency of 92%. They were described as the highest head Kaplan units in the US and physically only slightly under the largest ever built. Angle of the six blades can be adjusted in operation between 12 and 32 deg.

Cowans Ford plant will be remotely operated from Charlotte over a microwave link and can be brought to synchronism from stand-still in 2 min. Initial cost of the three-unit installation was given as $57 million; ultimate cost $62 million. Economic comparisons with equal steam capacity were 12% in favor of steam for the first three-unit installation but 6% in favor of hydro for the ultimate despite the 4.5% load factor, Wray said. Adjustable-blade Kaplan turbines were picked over fixed-blade Francis units after comparing turbine and generator cost, permissible spacing, structure cost, varying head and efficiency. Capitalized value of energy savings with the high-efficiency Kaplan units topped $1 million, it was stated.

Two papers described the Niagara Power Project; one on electrical features, the other on electrical controls and relaying. When finished in 1962 the $720 million project will have a total capacity of 2,190,000 kw. It comprises the 13-unit, 1,950,000-kw Robert Moses Plant, the Reservoir Pumping and Generating Plant with a 12-unit capacity of 240,000 kw and the Niagara Switchyard with its 115, 230 and 345-kv double-bus systems.

Niagara Switchyard Fed by Pipe Cable

T. E. Thorgersen, Charles T. Main Inc, specifically cited use of seven 115-kv and six 230-kv high-pressure oil-pipe-type cable circuits of 200 Mva to link the Moses Plant unit transformers with the switchyard. Four 100-Mva, 230-kv circuits tie the four Reservoir plant transformers with the switchyard. Use of these cables, in tunnels, eliminated costly design problems connected with use of overhead construction. They also made use of four breakers per switchyard bay feasible, freeing both ends of the bays for outgoing transmission lines.

Direct-buried cable was rejected because spacing would have required more area than tunnels, more excavation, special backfill, and larger conductors for the same loading. Tunnel construction permits forced-air cooling of cables. No more than three cables (600 Mva) are in one tunnel. This limits loss at Moses to ¼ of station output in event of disaster in any tunnel.

Contamination in the switchyard area lead to sectionalizing of the double buses into sections that can be shut down for cleaning. The bus systems are over-insulated. BIL ratings are held to 550, 900 and 1,300 kv on the nominal 115, 230, and 345-kv systems for

their bushings, potheads and insulator stacks.

In a companion paper on control and relaying, T. E. Thorgersen and J. Basilesco, also Charles T. Main Inc, described the automatic-sequence starting systems for units at Moses and Reservoir Plants. All units can be started by master switches at the main control room at Moses, pilot-wire supervisory control for the remote Reservoir Plant.

Transmission relay coordination in the Niagara Project uses microwave in the 6,000-megacycle band. The carrier spectrum proved too crowded to handle communication, vhf radio control, and telemetering in addition to relaying. Line relaying in general is accomplished by impedance-type distance relays with microwave transfer trip. But the importance to system stability of fast clearing on four circuits to the nearby (4 miles) Niagara Mohawk Packard Substation dictated use of two independent relay systems, one pilot-wire differential, the other an impedance-type scheme with microwave transfer trip.

Norman G. Dennis, Woodward Governor Co, in describing the performance of an electric-hydraulic governor for hydraulic turbines, commented sharply on the pointless popularity of one type over the other. The choice, he said, is not a question of "style" but of function and need. Electric governors are more flexible to plant layout and have adjustable deadband, but mechanical devices have superior speed resolution.

When hydro and steam generation are combined on a system, it is "natural" to consider it as two sub-systems, one all-thermal and the other all-hydro, said B. Bernholz and L. J. Graham, Ontario Hydro. Each operating mode of the hydro leads to a minimum for thermal. Optimum utilization occurs when hydro stations are so operated that the minimum cost of thermal generation is as small as possible, they said.

Distribution Focuses on Service Reliability

Three-stage Penn P&L attack seeks facts on interruptions, bolsters feeder strength, applies co-ordinated protection

■ A major drive to provide utility customers constantly improving service at acceptable cost was mapped in three papers prepared by Pennsylvania P&L Co engineers. Prolonged or frequent interruptions disrupt comfort or work and excessively long interruptions may jeopardize health or property, they said, while voltage must be suitable for satisfactory performance of all residential, commercial, and industrial devices.

Initial phase of this drive, said J. J. Malone, R. K. Moore and N. N. Smeloff, was to determine the number of customers interrupted, and the duration, frequency, and magnitude of the interruptions. Consideration must be given, they said, to special service requirements of particular areas and to such critical customers as hospitals and municipal services. Interruption data from field forces are coded onto punch cards showing location, cause, facility involved, and weather. They are then tabulated in monthly reports to evaluate customer service and pin-point service restorations, preventive maintenance, system design, and planning.

The second phase of this drive for improved service, according to J. E. Weed, R. K. Moore, and N. N. Smeloff, was aimed at bolstering the built-in reliability of 12-kv feeders. Objective was to correct deficiencies of older feeders stemming from obsolete design and construction or from deterioration, thus giving them the reliability of modern plant. Typical defects are inadequate splices and connectors, sub-standard clearances, excessive conductor sags, and obsolete equipment. Field inspection disclosed that these could be corrected for about 10% of the cost of new 12-kv feeders; this work will cut interruptions and save costly emergency restoration, they predicted.

Protection Coordinated

The third phase will provide improved protection coordination and fast automatic reclosing after transient faults which cause over 90% of distribution trouble, said J. E. Treweek, R. K. Moore, and N. N. Smeloff. This program is planned to protect life and property by clearing faults quickly and to protect service by confining interruptions to small areas. Cost is weighed against customers involved, difficulty in locating and repairing faults, and difficulty in picking up "cold" load. Application to a typical 12-kv feeder required two additional reclosers, five new line fuses, and replacement of 60 existing fuse links. Coordination is designed to protect all fuses against transient faults by a fast initial trip of the proper automatic device; if the fault persists after automatic reclosure, it will be isolated by blowing the nearest fuse during delayed subsequent trips, they said.

Industrials Need Utility Help

Teamwork between a utility and its industrial customers is the only hope of providing reliable electric service for today's automated processes, said M. M. Gilbert, E. I. du Pont de Nemours. Such processes are shutdown as completely by a 30-cycle interruption as by 30 min and sometimes require days to re-start. Accordingly the adequacy of utility service has become a prime consideration in selecting new plant sites, he said.

Recognizing that utility rates reflect system investment required to serve its customers, du Pont has adopted the policy of paying a rental charge for utility facilities provided to firm up the service, Gilbert said. In addition, du Pont at times provides in-plant generation for such critical devices as electronic process computers, and delays the dropout of motor controllers for drives which can tolerate a 30-cycle interruption. The utility supply and the plant's protective relays must be designed to ride through the inrush when utility service is restored, he warned.

Satisfactory coordination is always possible when utility-industrial joint planning weighs the probability

and cost of trouble in early design stages, said A. Hauspurg, AEP Service Corp. But this coordination is sometimes complicated by the lack of qualified electrical engineers available to small industrials building automated plants in sparsely-developed areas.

Service Estimates Help

Hauspurg suggested that utility engineers estimate the probable frequency of short and long interruptions. Then the customer's evaluation of loss from such interruptions can help the utility to determine what system connections can be justified. The utility can design lines to minimize fault probabilities, and provide fast relaying and circuit breakers to reduce outage time, but it cannot completely eliminate voltage dips, he said.

Voltage dip problems generally must be solved by the industrial's process designer, Hauspurg continued. Induction motors can usually be held on-line with delayed-trip controllers, but the total horsepower thus held on should not exceed 5% of symmetrical fault kva at the motor bus. Time delay becomes more complicated for synchronous motors, he said, as a slowdown exceeding 90 deg can cause instability which requires unloading and re-synchronizing.

In discussion, A. C. Friel, Dow Chemical Co, and H. H. Gnuse Jr, Alcoa, both praised AEP's policy of advising customers how many faults they should expect. The unwillingness or inability of other utilities to provide such information seriously hampers industrial managements seeking to determine what facilities are needed in plant electrical systems, they said.

Plant Relays Must Coordinate

Plant relaying also should be considered and coordinated with the utility in early design, said W. E. Marter, Duquesne Light Co. A customer should not expect to use slow relaying on his connection to a utility using fast clearing as it permits a fault in his plant to cause a long voltage dip which is detrimental to his own service and that of other plants in the area.

In discussion, H. H. Gnuse Jr suggested that utilities present coordination tables or curves to the customer during rate and regulation discussions. A non-technical industrial management could pass this information along to its consultant or contractor early enough to be reflected in the facilities.

"How effectively are industrials facing up to their enlarged relaying responsibilities? What is the role of the utility, the consultant, the electrical manufacturer, the staff engineer? And what about maintenance?" These questions—and more like them—spurred J. J. O'Connor and Norman Peach, POWER, to survey 27 industrial systems. They found a "growing vacuum." Contributing causes, they concluded, were the efforts of utilities to divorce themselves from customers' relay problems and customer unawareness of the role relays play in their plants' day-to-day production.

"Systematic testing is required to assure that protective devices provide protection when trouble occurs," said T. M. Urban, Multi-Amp Electronic Corp, speaking for R. J. Dikeman Jr and R. M. Shoop. "With modern test equipment it is possible and economically feasible to [achieve] continuous production."

The electrical industry should adopt the "unitary" theory in any future standardization of distribution and electrical-device voltage ratings, suggested A. S. Anderson, Ebasco. Thus motors for operation on a 240/416-v system would carry a 416-v rating as would the supply transformers. In discussion, this proposal was warmly endorsed by three utility engineers, one of whom proposed abandoning the 440-v motor rating, and by several airconditioner engineers.

Aluminum has a definite place in substation design, said G. E. Heidenreich, Cincinnati G&E, but should be compared with copper or steel to select the best for each application. Aluminum angles are proving more convenient than tubing for buses, using compression terminals shop-welded to the bus for tubing or rod leads to be connected in the field. Aluminum can also be used to advantage in low structures and for station fencing, Heidenreich continued, but has made slow progress against steel for line-terminal towers where stresses are severe.

Interruption Estimates Help Industrials Plan System

System	Interruption Time		Voltage Dip
	Minimum	Maximum	
Radial	¼ Sec.	Several hours to repair damage	Same as source bus
Loop	¼ Sec.	¼—1 hour to sectionalize loop	Reduced by loop support
Loop with motor-operated switches	¼ Sec.	1 Min	Reduced by loop support
Loop with circuit breakers	0	0	Reduced by loop support

Debris Control Facilities Planned For Columbia

Grant County Public Utility District and Chelan County Public Utility District have joined in a cooperative arrangement with three federal agencies to construct debris control facilities on the Columbia River above Grand Coulee Dam.

The three agencies are the Bureau of Reclamation, National Park Service and the Corps of Engineers. The Bureau will build, operate and maintain the debris control facilities on Franklin D. Roosevelt Lake (Grand Coulee Dam reservoir). Costs will be borne on a prorated basis by dam operators based on installed capacity. The action resulted from recommendations made by the Columbia Basin Interagency Committee last year.

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Surveys—Appraisals—Reports
Technical Publications
Boston · Washington · New York

JENSEN, BOWEN & FARRELL
Engineers
Appraisals—Depreciation Studies—Property Records
Cost Trends—Special Studies—Reports
for Rate Cases, Security Issues, Regulatory and
Accounting Requirements
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NOrmandy 8-7778

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Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
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Engineers
Electric, Steam and Hydraulic Projects,
Investigations, Reports, Appraisals
Design and Construction Supervision
Boston, Mass. — Charlotte, N. C.

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Consulting and Design
Engineers—Purchasing
Specialists in Financing
Accounting and other Operations
231 So. La Salle St. — Chicago 4

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Engineers
Consultants to the Power Industry
STUDIES • DESIGN • SUPERVISION
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Consulting Engineers
Mechanical • Electrical • Thermodynamic
Structural Design • Studies • Supervision
Power Stations • Transmission • Distribution
Industrial Plants • Process
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214 Meadows Building — Dallas, Texas

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Construction and Maintenance
Transmission - Distribution
Electric and Telephone Lines
Consultants
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VERNON GRAPHICS, INC.
Mount Vernon, N. Y.
MO 4-7117

VERNON GRAPHICS OF PA. INC.
Norristown, Pa.
Broadway 9-3000

CONSULTING AND SERVICING UTILITIES
ON MAPS, RECORDS AND FIELD INVENTORY

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EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

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EMPLOYMENT OPPORTUNITIES: $25.50 per inch. Subject to Agency Commission.

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PROPOSALS, $1.80 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

Send New Advertisements to Classified Advertising Div. of Electrical World. P. O. Box 12, N. Y. 36, N. Y.

FOR SALE

Williams Pole Hole Digger

Model ADH-1, Skid Mounted. Continental F226 Red Seal Engine. New in 1957. In excellent working condition. Complete with 9", 11", 13", 16", and 30" Heavy-duty Pengo Augers. Going at a good price. Contact Purchasing Dept.,

A. B. CHANCE CO.

Centralia, Mo.

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

• POSITIONS VACANT

Electrical Engineer, about 32, with 5 years experience in the electric distribution and transmission division, particularly familiar with construction and estimating with some selling experience. Location with Ohio Electrical Line Contractor. Please furnish detail experience and qualifications. P-6844, Electrical World.

Electrical Engineer, Central Illinois utility has opening in substation design, transmission design and communications for engineer with a degree. Previous experience in these fields desirable. Salary up to $9,000. Send resume of education and experience to P-6973, Electrical World.

Three Chief Operators with Public Utility experience for 80,000 KVA Hydroelectric Plant in East Pakistan. One year contract at $1000 per month with subsistance, housing and transportation furnished. All qualified applicants will be considered without regard to race, creed, color or national origin. Send resume of experience to Utah-Parkistan Inc., 221 Pine Street, San Francisco, California.

General Manager—For Ipswich Municipal Electric Department. Salary depends upon qualifications. KWH sales about 25,000,000 from our generating plant to 3000 consumers. Write to Personnel Department, Town Hall, Ipswich, Massachusetts for application and more details.

• SELLING OPPORTUNITY AVAILABLE

Representative wanted for manufacturer of street lighting equipment, pole line specialties. States of Georgia, Washington, Oregon, North and South Dakota, Illinois, Iowa. Full particulars. RW-6918, Electrical World.

• SELLING OPPORTUNITIES WANTED

Experienced manufacturers representative with engineering background seeking electrical lines in Hawaii. RA-7035, Electrical World.

Industrial representative established Texas Gulf Coast offers engineering and sales service to manufacturer of major equipment or apparatus. Write Electric Apparatus Co., P. O. Box 2034, Houston 1, Texas.

TRANSMISSION ENGINEER

Staff position for graduate Electrical Engineer with substantial experience in transmission line design, sag and tension calculations, economic studies, cost estimating, selection of conductors and structures, preparation of specifications and evaluation of quotations of suppliers. Headquarters New York City.

Send resume, in confidence, to:
Box P-6782, Electrical World
Class. Adv. Div.
P. O. Box 12, N. Y. 36, N. Y.

DESIGN OPPORTUNITY

We need a creative electrical design guyed engineer for advanced work on guyed tower and other transmission structures of large power systems.

If your knowledge, ability, record and practical experience meet requirements, major manufacturer is ready to add to staff.

Write for interview:

P-7025, Electrical World
255 California St., San Francisco 11, Calif.

WANTED FOR EXPORT—USED

Complete Power Plants
High Pressure Boilers
Turbo-Electric Generators
Diesel-Electric Generators
Hydro-Electric Generators

OFFERED—NEW

Factory new Turbo-Electric Generator, 22,000 K.W. 13800V, 3 ph. 60 cy. 3600 RPM, 850 PSIG, 900° F. New Boiler to match.

TRACTORS FOR EXPORT, INC.
170 Broadway New York 38, N. Y.
Our 20th year.

TRANSFORMERS

3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
3—1000 KVA G-E 34500-7200/12470Y
3—1000 KVA Wag. 34500—2400/4160Y
3— 833 KVA W-H 43800—480
3— 667 KVA G-E 13200—2400/4160Y
3— 500 KVA Penn. 13200—120/240
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA G-E 2400/4160Y—240/480
3— 333 KVA Wag. 2400—120/240
1—1500/1875 KVA Mol. 3-Ph. 40,500—4800 F/C equipped
1—1500/1875 KVA Mol. 3-Ph. 34,500—2400 F/C equipped

TRANSFORMERS WANTED

THE ELECTRIC SERVICE CO.

5316 Hetzel St.
Cincinnati 27, Ohio
47 Years' Dependable Service

PRODUCT SUPERVISOR

Graduate Electrical Engineers with experience in application of Paper, Rubber and Plastic insulated electrical cable to supervise product function at company's Virginia headquarters. Ideal opportunity for qualified men to participate in a basic aluminum producer's first activity in the copper cable field. Salary commensurate with qualifications. Complete benefits program effective first day of work.

Address replies and resumes to:

J. E. Betts
Assistant Manager, Sales Personnel
Reynolds Metals Co.
Richmond, Va.

Somebody—Somewhere,
needs your idle equipment! Reach that buyer quickly and economically thru the
"SEARCHLIGHT SECTION"
The meeting place of Used Equipment Buyers and Sellers

Meetings Calendar

JULY

Edison Electric Institute—Industrial Relations Committee, Roosevelt Hotel, New York City, July 20.

AUGUST

Western Electronic Show & Convention—Cow Palace, San Francisco, Aug. 22-25.

American Institute of Electrical Engineers—Pacific General Meeting, Hotel Utah, Salt Lake City, Aug. 23-25.

American Society of Mechanical Engineers—International Heat Transfer Conference, University of Colorado, Boulder, Aug. 28-Sept. 1.

American Institute of Mining, Metallurgical, & Petroleum Engineers—Third Annual Semiconductor Conference, Ambassador Hotel, Los Angeles, California, Aug. 30-Sept. 1.

SEPTEMBER

Association of Illinois Electric Cooperatives—Annual Meeting, Springfield, Illinois, Sept. 6-8.

Northwest Public Power Association—Power Use Section Annual Workshop, Pacific University, Campus, Forest Grove, Oregon, Sept. 6-8.

National Rural Electric Cooperative Association—Region IV Meeting, Columbus, Ohio, Sept. 7-8; Region V Meeting Eau Claire, Wisconsin, Sept. 11-12; Region III Meeting, Alabama, Sept. 25-26; Region I Meeting, Richmond, Virginia, Sept. 28-29.

Rocky Mountain Electrical League—Annual Fall Convention Jackson Lake Lodge, Moran, Wyoming, Sept. 10-13.

Edison Electric Institute—AGA, Accounting Section Organization Meeting, The Netherland Hilton Hotel, Cincinnati, Ohio, Sept. 11-12; Meter and Service Committee, Hotel Leland, Springfield, Illinois, Sept. 24-27; Industrial Relations Committee, Annual Round Table Conference, Drake Hotel, Chicago, Sept. 25-27.

Engineering Management Meeting—Sponsored by AIEE, ASME, Hotel Roosevelt, New York City, Sept. 14-15.

Public Utilities Association of Virginia—43rd Annual Meeting, The Greenbrier, White Sulphur Springs, W. Virginia, Sept. 14-15.

American Institute of Electrical Engineers—Petroleum Industry Conference, Jung Hotel, New Orleans, Sept. 17-20.

• **NEMA**—Technical Committee, Power Circuit Breaker group, NEMA office, New York City, Sept. 19; Codes and Standards Committee, NEMA office, New York City, Sept. 28-29.

Electric Companies Public Information Program—1961 Workshop Conference, Brown Palace Hotel, Denver, Sept. 20-22.

Northwest Electric Light & Power Association—54th Annual Meeting, Sheraton-Portland Hotel, Portland, Sept. 20-22.

Missouri Valley Electric Association—Accounting Conference, Sheraton-Jefferson Hotel, St. Louis, Sept. 21-22; Sales, Rural and Home Service Conference, President Hotel, Kansas City, Sept. 27-29.

National Power Conference—Sponsored by American Institute of Electrical Engineers, and American Society of Mechanical Engineers, St. Francis Hotel, San Francisco, Sept. 24-27.

Pennsylvania Electric Association—Accident Prevention Committee, Bellevue Stratford, Philadelphia, Sept. 25-26; Annual Convention, Bellevue, Stratford, Philadelphia, Sept. 27-28.

Southeastern Electric Exchange—Accounting Section, Atlanta Biltmore Hotel, Atlanta, Sept. 28-29.

OCTOBER

American Gas Association—Annual Convention, Dallas, Texas, Oct. 1-4.

Electric Council of New England—Management Training Course, Bald Peak Colony Club, Melvin Village, N. H., Oct. 1-7; Residential Sales Workshop, Hotel Wentworth-By-The-Sea, Portsmouth, N. H., Oct. 2-3; 5th Annual Conference, Hotel Somerset, Boston, Mass., Oct. 18-20.

Electrical World's Fifth Electric Heating Conference—Sheraton-Park Hotel, Washington, D. C., Sept. 25-26.

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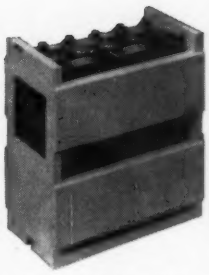
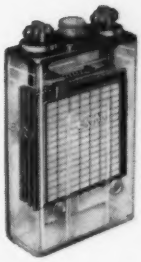


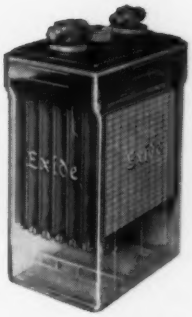
Low-maintenance pocket positive nickel-cadmium

New 20-year Exide-Ironclad tubular with Silvium*

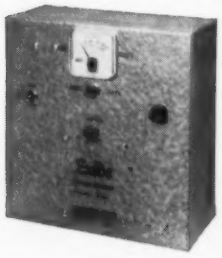
MATCH BATTERY POWER TO YOUR NEEDS AND SAVE MONEY



Flat plate Tytex with Silvium or calcium



Long life Exide-Manchex, Planté type, with Silvium



Trickle or Hi-Lo charger

Constant voltage charger

This is what you get in the Exide Power Package. For your particular application, you need a particular type and size battery for maximum economy. Then you need a particular charger. And you need a certain amount of regular service.

Exide is in the unique position to provide the exact battery, charger and service that your particular application requirements call for. Only Exide offers so broad a line of batteries and chargers. And only Exide has such a well-trained field force of factory supervised service specialists.

An Exide Power Package not only insures you of getting the power you need, but it protects you from overspending on capacity you don't need.

And you get everything from one dependable source. It's your easiest, surest way of getting maximum battery power economy. Write for complete information. Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

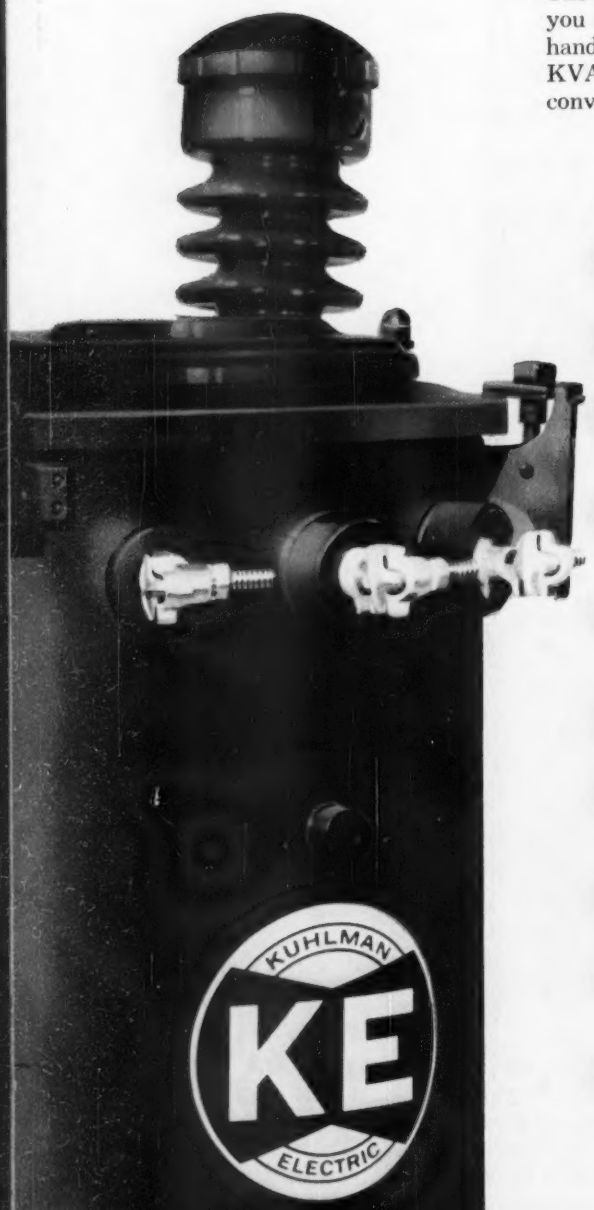
*Silvium is Exide's patented corrosion-resistant grid alloy

Exide®

INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company

ESB

10 Kuhlman improvements
10 ways to save operating costs



The Kuhlman transformers you buy today are 10 ways better than those you bought just two years ago. Designs are lighter, smaller, easier to handle, easier to maintain and more economical to operate. You get more KVA per pound, more economy per KVA, longer life, more labor-saving conveniences, more hidden value.

Here are 10 Kuhlman improvements and the 10 ways you save:

1. **Dual-Ratings**—All Kuhlman pole-type transformers offer two ratings with 12% additional KVA at the higher rating.
2. **Longer-Life Insulation**—Kuhlman super insulation with improved thermal aging characteristics, lengthens transformer life.
3. **Double Line Protection**—(1) Covered line connections (2) Insulated transformer covers give double protection against outages caused by wildlife.
4. **Special Insulated and Shielded Windings**—Special primary shield and end-turn insulation gives greater protection against lightning and switching surges.
5. **Lighter, Smaller Designs**—Weights have been cut up to 50%. 500 KVA units now weigh 3100 lbs.; 333 only 2200 lbs. All ratings are lighter and smaller.
6. **New "Lucite" Finish**—This finish stays brighter—weathers longer—has the lowest erosion rate of any finish available today.
7. **More Performance per KVA**—All ratings have lower impedance, better regulation, lower losses, better performance guarantees than previously.
8. **Improved Short-Circuit Capability**—Especially coated layer insulation results in mechanically stronger coil structures.
9. **A Completely Different HV Bushing**—The only bushing of its kind, having unique clamping sleeve and radio noise free characteristics.
10. **Easier Installation and Maintenance**—White interiors, internal clamping, hand grip connectors, and other Kuhlman features simplify handling and maintenance.

Ask your Kuhlman representative for more facts about 10 ways Kuhlman transformers save operating costs.

KUHLMAN TRANSFORMERS

KUHLMAN ELECTRIC COMPANY, Birmingham, Mich.

Manufacturers of transformers since 1894

FACTORIES: Bay City, Mich. • Crystal Springs, Miss. • Salinas, Calif.